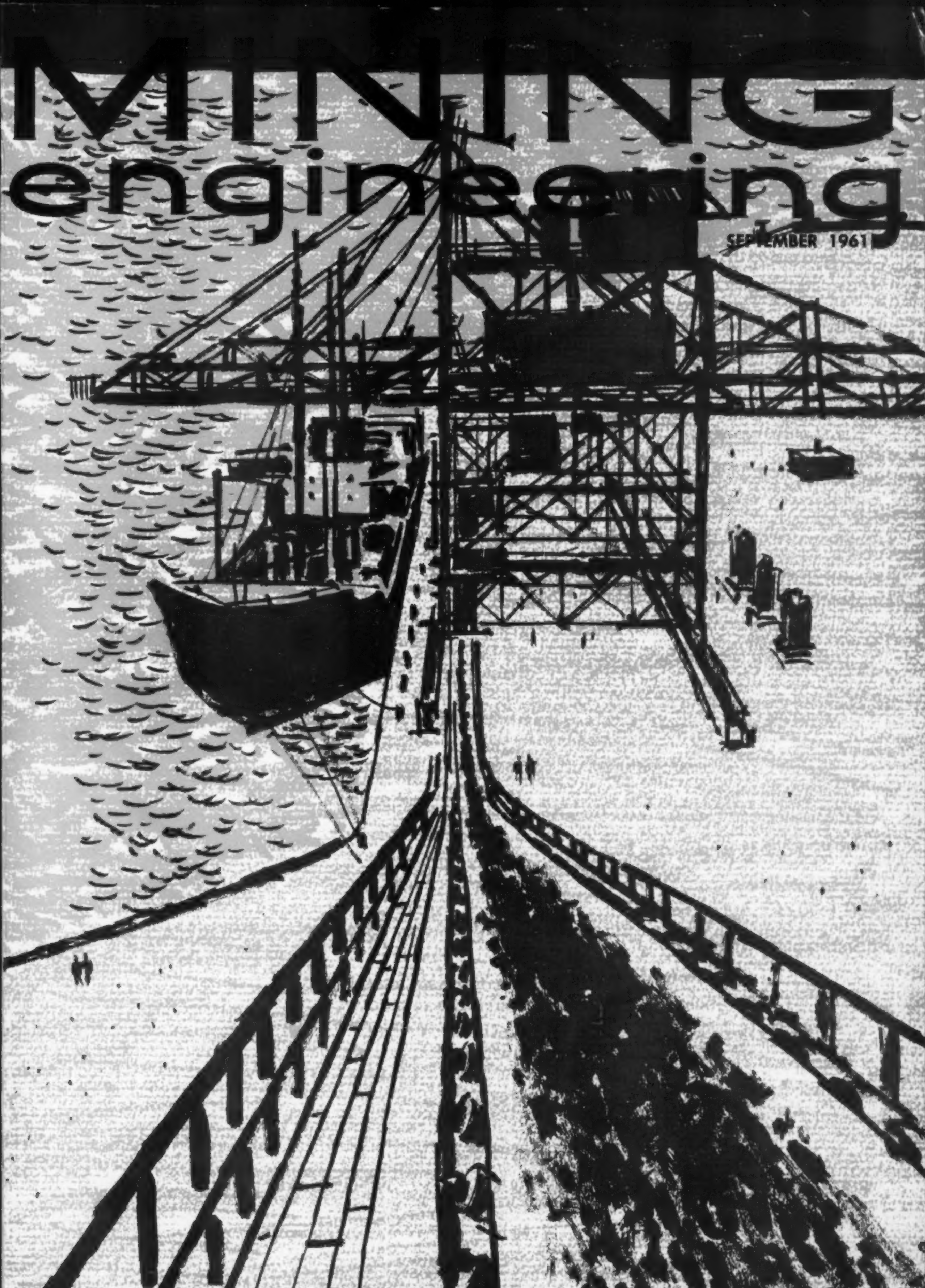
MINING engineering

SEPTEMBER 1961



COMING EVENTS

Sept. 17-20, Commemoration of the 50th Anniversary of Froth Flotation in the U.S.A., sponsored by AIME: Society of Mining Engineers' Minerals Beneficiation Division, Brown Palace and Cosmopolitan Hotels, Denver.

Sept. 18-20, 10th Annual Meeting Standards Engineers Society, Hotel Sherman, Chicago.

Oct. 2-3, Joint Meeting, Industrial Minerals Division of SME of AIME—CIM, Chateau Laurier Hotel, Ottawa.

Oct. 3-4, Southern Research Institute, Dinkler-Tutwiler Hotel, Birmingham.

Oct. 5-7, AIME-ASME Joint Solid Fuels Conference, Dinkler-Tutwiler Hotel, Birmingham.

Oct. 15-18, International Mining Days sponsored by the New Mexico Mining Assn. and the El Paso Chamber of Commerce, Hilton Hotel, El Paso, Texas.

Oct. 18-21, AAPG Mid-Continent Regional Meeting, Amarillo, Texas.

Oct. 25-27, 11th Annual Meeting Gulf Coast Assn. of Geological Societies, Granada Hotel, San Antonio, Texas.

Oct. 25-28, 14th Pacific Coast Regional American Ceramic Society Convention, Jack Tar Hotel, San Francisco.

Nov. 1-3, Southwestern Federation of Geological Societies Fourth Annual Meeting, El Paso, Texas.

Nov. 3, Pittsburgh Sections of AIME and NOHC Off-the-Record Meeting, Penn-Sheraton Hotel, Pittsburgh.

Nov. 3-4, Joint Meeting Central Appalachian Section, AIME and the West Virginia Coal Mining Institute, The Greenbrier, White Sulpher Springs, W. Va.

Nov. 4, Carolinas Section, AIME, annual meeting, Barringer Hotel, Charlotte, N. C. For information write Neil O. Johnson, Foote Mineral Co., Kings Mountain, N. C.

Nov. 5-9, 31st Annual International Meeting of the Society of Exploration Geophysicists, Denver.

Nov. 13-15, Steel Founders' Society of America Technical and Operating Conference, Hotel Carter, Cleveland.

Dec. 4, Annual Meeting Arizona Section of AIME, Pioneer Hotel, Tucson, Ariz.

Dec. 6-8, Nineteenth Electric Furnace Conference, sponsored by The Metallurgical Society of AIME. Penn-Sheraton Hotel, Pittsburgh.

Jan. 15-17, 1962, AIME Minnesota Section Annual Meeting-University of Minesota 23rd Annual Mining Symposium, Hotel Duluth, Duluth.

Feb. 18-22, AIME Annual Meeting, Statler-Hilton & Astor Hotels, New York City.

Mar. 12-13, Steel Founders' Society of America Annual Meeting, Drake Hotel, Chicago.

Mar. 26-29, AAPG-SEPM Annual Meeting, jointly with AAPG-SEPM-SEG Pacific Sections, Civic Auditorium, San Francisco. Fairmont Hotel to be hotel headquarters.

Apr. 9-11, 45th National Open Hearth and Blast Furnace, Coke Oven and Raw Materials Conference, sponsored by The Metallurgical Society of AIME. Sheraton-Cadillac Hotel, Detroit.

Apr. 12-14, Pacific Southwest Mineral Industry Conference, Palace Hotel, San Francisco.

Apr. 23-25, 12th Annual Meeting, Rocky Mt. Section, AAPG, Salt Lake City.

Apr. 26-28, AIME Pacific Northwest Metals and Minerals Conference, Ben Franklin Hotel, Seattle, Wash.

May 7-9, American Mining Congress Coal Convention, Pittsburgh.

May 7-11, American Foundrymen's Society 66th Annual Castings Congress & Exposition to be held in conjunction with the 29th International Foundry Congress, Cobo Hall, Detroit.

June 4-6, 1962, Nuclear Congress and Atomic Exposition, New York Coliseum, New York City.

June 7-8, Coal Division Field Meeting, Price, Utah.

MINING engineering

SOCIETY OF MINING ENGINEERS AIME

VOL. 13 NO. 9 **SEPTEMBER 1961**

COVER *Very few scenes are more typical of America's iron ore industry than the dock unloading facilities for Great Lakes ore carriers. Serving for this month's cover by artist Herb McClure, it is but one facet of the industry—the "Big Picture" will be found commencing on page 1052.*

ARTICLES

DEPARTMENTS

FEATURED ITEMS

MINING ENGINEERING staff, Society of Mining Engineers, and AIME Officers are listed with "The Drift Of Things". Number of copies printed of this issue: 15,500.

Address insertion orders and copy to MINING ENGINEERING, 345 E. 47th St., New York 17, N. Y. Send plates to: MINING ENGINEERING, c/o Lew A. Cummings Co. Inc., 215 Canal St., Manchester, N. H. Published monthly by the American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc., 345 E. 47th St., New York 17, N. Y. Telephone: PLaza 2-6800; TWX NY 1-1304. Subscription $8 per year for non-AIME members in the U. S., & North, South, & Central America; $10 all other countries; $6 for AIME members, or $4 additional for members only in combination with a subscription to "Journal of Metals" or "Journal of Petroleum Technology". Single copies, $.75; single copies foreign, $1.00; special issues, $1.50. AIME is not responsible for any statement made or opinion expressed in its publications.

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PERSONNEL

THESE items are listings of the Engineering Societies Personnel Service Inc. This service, which cooperates with the national societies of Civil, Chemical, Electrical, Mechanical, Mining, Metallurgical, and Petroleum Engineers, is available to all engineers, members or non-members, and is operated on a nonprofit basis. If you are interested in any of these listings, and are not registered, you may apply by letter or resume and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular placement fee. Upon receipt of your application a copy of our placement fee agreement, which you agree to sign and return immediately, will be mailed to you by our office. In sending applications be sure to list the key and job number. When making application for a position include 8¢ in stamps for forwarding application. A weekly bulletin of engineering positions open is available at a subscription rate of $4.50 per quarter or $14 per annum, payable in advance. Local offices of the Personnel Service are at 8 W. 40 St., **New York 18;** 57 Post St., **San Francisco;** 29 E. Madison St., **Chicago 1.**

In addition to the listings below, ESPS maintains a more complete file of general engineering positions and men available. Contact nearest ESPS office, listed above.

MEN AVAILABLE

Mine Manager or Mill Superintendent, B.S. in mining engineering, age 50. Experience: one year sales engineer for milling and heavy construction equipment; 12 years mill superintendent Pb-Cu-Zn flotation plants; eight years manager; all in South American mines. Fluent Spanish. M-620.

Mining Engineer, graduate mining engineer, age 45, good health. Twelve years all phases exploration, mine engineering, mine operation. Open pit or underground. Presently employed. Location open. M-621.

Manager-Production Engineer, B.S. in mining engineering from University of Arizona. Ten years underground engineering and supervisory capacities in gold, copper and Ag-Pb-Zn mines; seven years open pit aluminum and nickel cobalt projects as engineer in charge. West. M-622.

Mining Engineer, Petroleum, Geophysicist, Geologist, B.S., E.M., M.S., Ph.D. degrees in physics and geology. Experienced in organization and direction of exploration department; planning, programming, cost, estimating, supervision, interpretation of airborne and ground geophysical surveys in minerals and petroleum on all continents. Location open. M-623.

Manager or Liaison Assistant to Management, B.S. in geology, age 48. Experienced in production and administration of small to multi operations. East to Midwest. M-2227-Chicago.

Geological Engineer or Mining Engineer, graduate geological mining engineer, age 30. One and one-half years mineral exploration covering all types of mineral deposits including geological, geophysical and geochemical evaluations; two and one-half years in copper mine development covering geological, drilling and sampling evaluations; one and one-half years uranium production and development covering geological, grade control, underground and surface drilling evaluations; one-half year geological draftsman. West or South. M-2228-Chicago.

Superintendent-Mining, mining engineer, age 48. Three years experience operating underground and open pit mine, organizing and operating project from development through production. $800. Prefer western U.S. Home: Idaho.

Junior Engineer-Mining, mining engineer, age 26. Recent graduate with some experience in surveying, mapping, exploration, drafting and general construction. $500. Prefer Southwest. Home: California. Se-1352.

Geologist-Mining, age 26. Recent graduate with experience in geology as assistant, mine surveying, sampling stopes and drifts, core logs, stope maps, percentage and tonnage reports, use of transit and brunton. Limited mining experience in rock bolting, timbering, drilling and loading holes. Prefer South America. Home: Idaho. Se-860.

Chief Engineer, Superintendent-Mining, mining engineering, age 31. Over seven years experience including construction and maintenance of all mining facilities, plan engineering and design construction activities of mine and mill, supervise work required for water supply, layout and plan all future mining operations, supervise exploration crews, mine surveying, supervise miners, compute ore reserves, layout track work and haulage roads. $650-$700. Prefer Northwest U.S. Home: Montana. Se-1719.

POSITIONS OPEN

Project Engineer, graduate mining, chemical or mechanical engineering, with experience in mineral dressing, crushing, grinding, classification, roasting and drying of minerals and materials, to perform these functions as required in the preparation of abrasive grains and powders. Salary open. Upstate New York. W541.

Director of Industrial Engineers, B.S. degree in mining, mechanical or industrial engineering, with M.S. advantageous, with 10 years experience in industrial engineering including five years in supervisory position. Experience must cover industrial engineering techniques such as time and motion study, ratio delay, methods engineering, wage incentives, cost accounting, etc. Employment on contract basis in multiples of two years, home leave vacation of two months at end of two year contract. Transportation both ways. South America. F361.

Mining Engineer, young, with experience on stripping operations for pegmatite project. $8000. Brazil F352.

Mineral Dressing Engineer, recent graduate, with original ideas, to develop improved beneficiation procedures and new uses for wide variety of industrial minerals. Pleasant working conditions in well equipped growing research organization. Salary open. Southeast. W428.

Staff Engineer, beneficiation, 35-50, with a minimum of 15 years experience, graduate or professional engineer, thoroughly experienced in ore beneficiation as applied to the iron and steel industry. Must be capable of assuming consulting or supervisory duties. Midwest. W298 a).

Mining Engineer, graduate, age to 30. Four years experience in mining, handling plant projects, equipment, methods modernization, plant layout. Background in mining helpful for silica mine. $7800 depending on experience. Employer will pay fee. Sixty miles southwest of Chicago. C8717.

Junior Mining, Metallurgical Mill, Mine, recent graduate, single status, some knowledge of Spanish. For expansion of existing mill and mine facilities, possibly later into production. $375 plus room and board and traveling, liberal vacation, retirement plan, 10 pct bonus, two weeks vacation after one year, six weeks after second year, company will pay foreign income tax in Central America. Sj-6275.

ABSTRACTS

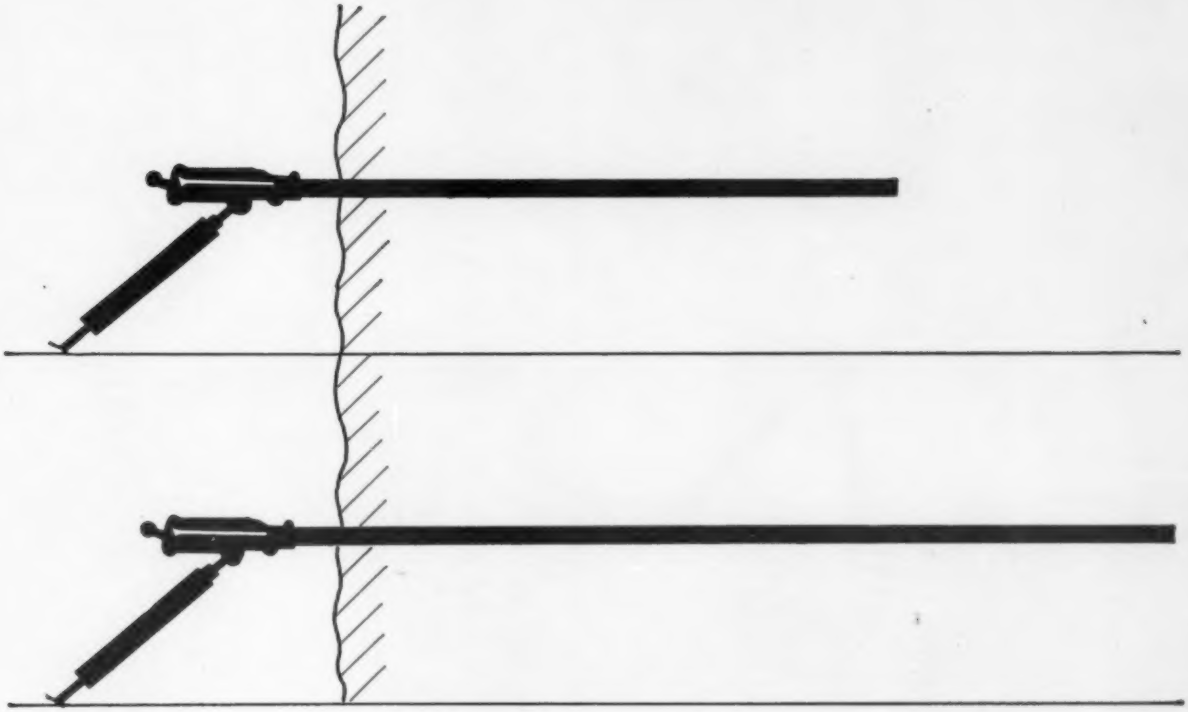
In This Issue: *The following abstracts of papers in this issue are reproduced for the convenience of members who wish to maintain a reference card file and for the use of librarians and abstracting services. At the end of each abstract is given the proper permanent reference to the paper for bibliography purposes.*

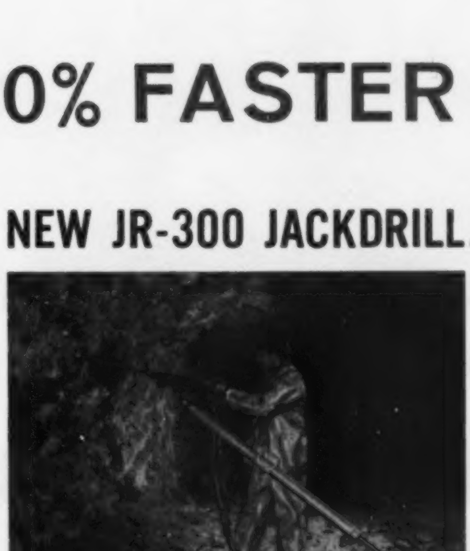
Iron Ore: The Big Picture by *E. H. Rose*—The history of the mining and beneficiation of iron ore in the U.S. coupled with a look to the future is presented. Statistics are presented for the outlook for high grade concentrate (+ 6 pct Fe) from new sources in the U.S. and Canada. Similarly the author presents expected and possible tonnage of direct shipping ore to be imported to the U.S. for the years 1960, 1965 and 1970 plus statistics of actual imports for the years 1950 and 1955. **Ref.** (MINING ENGINEERING, **September 1961) p. 1052.**

Proper Preparation of Data Aids Analyses for Mine Hoist by *A. W. Brune*—A method of tabulating data required for determining the size of cylindrical and conical drums for conventional mine hoists is presented. Such tabulation keeps all the necessary figures readily available for determining the size of a mine hoist for any mining property. **Ref.** (MINING ENGINEERING, **September 1961) p. 1059.**

Exploration of the Kings Mountain Pegmatites by *T. L. Kesler*—The author presents the first descriptive analysis of the exploration program conducted by Foote Mineral Co. at its Kings Mountain lithium mine. Unzoned lithium pegmatites occur with altered breccias that guided intrusion. Twenty percent of all the pegmatite is spodumene containing 97.6% of the lithia. Diamond drilling, of which 38% is in ore, is done in vertical sections controlling a gross reserve

(Continued on page 1017)





Three P&H Electrics are working at Craigmont's open pit mine on the side of Promontory Hill at an elevation of 4200 feet. To date, the three 4½-yd. P&H Electrics have loaded out over 250,000 tons of ore for stockpiling at the mill plus well over 1,500,000 tons of waste rock.

AT NEW COPPER MINE IN BRITISH COLUMBIA...

Magnetorque equipped P&H electrics

CRAIGMONT MINES LTD., uses three 4½-yd. P&H Electric Mining Shovels to move 1,700,000 tons of overburden and ore during first 2½ months on the job.

The new mine, 9 miles west of Merritt, is the first major base metal ore deposit found in British Columbia in 40 years. To work it, Craigmont Mines purchased three P&H Electrics. They are very pleased with the production obtained to date. It has exceeded estimates by an average of 25%.

20 to 25 Second Work Cycles

Magnetorque Hoist Drive combines with P&H Static Electronic Control to provide fast cycling speed. Each of the 3 P&H Electrics is loading out an average of 7,000 tons per eight-hour shift. The operators say that P&H Static Electronic Control, with its ease of operation, lets them put in a full 8 hours without tiring toward end of the shift.

Magnetorque Makes the Big Difference

On the job, the P&H Electrics get full dippers every pass. It's due primarily to exclusive Magnetorque. This A.C. motor direct-driven, eddy-current coupling provides higher bail pull . . . delivers the P&H Electrics' exceptional digging power at uniformly high speed during the dippers entire pass through the bank. And it does so without need for dipper mani-

P&H Magnetorque Hoist Drive automatically provides higher bail pull, extra power to meet increasing resistance in the bank and maintains uniformly high dipper speed while digging.

P&H Static Electronic Control responds instantly . . . provides fast, precise spotting and highest productivity.

exceed output expectations by 25%

pulation to avoid stalling. Result—faster digging and better fill factor.

P&H Electrics Highly Recommended

In addition to price and delivery, prime factors in the selection of these P&H Mining Shovels to supply this 4,000 ton-per-day mill included: favorable recommendations from other owners about the performance of their P&H shovels, as well as favorable comments about the speed and reliability of P&H parts and service.

Before you buy an electric mining shovel—make sure you've compared all performance factors. For more information on the Craigmont operation, write for Case History Report No. 150 to Harnischfeger, World's Largest Builder of Full-Electric Shovels.

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W. E. HEINRICHS, JR.
1955

R. E. THURMOND, JR.

PEELE AWARD FUND ESTABLISHED

In 1953, the Mining and Exploration Division established the Robert Peele Memorial Award to honor the distinguished mining engineer, educator, and author. Given for the most outstanding paper on a mining or exploration subject published in the Mining Transactions volume during the period under review and to AIME members not over 40 years of age at the time the paper was submitted, the purpose of the award was to stimulate the writing of technical articles and to provide an incentive to the younger members.

1956

I. JANELID

1957

L. A. PANEK

Robert Peele directed the editing and publishing of the first mining engineering handbook. Since it first appeared in 1918, The *Mining Engineer's Handbook* or "Peele", as it is generally known, has been the standard reference for the profession.

That the Division established an award in Robert Peele's name is fitting. Initially it was hoped that MINING ENGINEERING would be able to provide the necessary funds to finance the award—a certificate and $100. However this was not possible and the award was financed by the personal contributions of committee members. Awards were made to the men shown on this page during the years 1955 to 1959 inclusive, but in fairness to committee members, the award was then suspended until adequate financing could be assured.

During the past several years, Executive Committees of the M&E Division have studied the matter and decided that a permanent fund should be established. Action toward implementation of this decision was postponed during the United Engineering Building Fund Campaign at the request of the AIME Board of Directors. With permission granted at the June 20th AIME Board Meeting, the M&E Division Executive Committee has established a "Fund for Peele."

1958

A. F. AGNEW

1959

F. R. JONES

The "Fund for Peele" has as its objective the sum of $10,000—*or less than $1.00 for each SME member who has expressed an interest in the fields of mining and exploration!* A "Fund for Peele" Committee has been appointed to organize the drive to revive this coveted award. Composed of J. M. Ehrhorn and J. C. Fox, the Committee will welcome all contributions. Please send your check for $1.00 or more to "Fund for Peele" Committee, c/o Society of Mining Engineers of AIME, 345 East 47th Street, New York 17, N. Y.

The Robert Peele Memorial Award

To Honor Peele—To Honor A Member

ABSTRACTS

(Continued from page 1012)

of more than 35 million tons. **Ref.** (MINING ENGINEERING, **September 1961) p. 1062.**

Present State of Coal Flotation in West Germany by *K. H. Sallmann*—The main reasons for the growing importance of coal flotation in West Germany are the increasing moisture content of the run-of-mine coal which leads to the formation of slurry and slimes instead of dust, the better price obtainable when selling prepared slimes as fine coal, preferably as coking coal, and often the necessity for lowering the ash content of the slimes to make them more suitable for power generation. The author gives some statistics on German coal flotation plants and information on the properties of the feed and the quality of the derived products. The machines used are generally of the minerals-separation standard type or Fahrenwald type, and the trend is to use phenol-free reagents because of water pollution regulations. Concentrates are ordinarily dewatered by vacuum filters, but some work has been attempted using centrifuges. Tailings rejection becomes most difficult if there are no settling ponds available. Thickening, pumping of the thickened pulp to the dead rock heap (refuse or gob pile) and dewatering with filter press or centrifuges have all been tried. Tests have been made on the use of the tailings for making cement or brick. **Ref.** (MINING ENGINEERING, **September 1961) p. 1069.**

Preparing Men for Mining's Future by *Evan Just*—Various viewpoints on preparing students for the mining professions are analyzed. The author presents his own views as an educator and makes a plea for industry and educators to get together on an adequate and proper curricula which will attract the industry's share of qualified students to prepare for the needs of the future. **Ref.** (MINING ENGINEERING, **September 1961) p. 1074.**

SME Meeting Papers: *The following abstracts of papers presented at SME meetings are given for your information. Copies of these papers are available* **only if followed by a preprint order number.** *These preprints are obtained on a coupon basis. The coupon books may be purchased from SME headquarters for $5.00 a book (10 coupons) for members of AIME or $10.00 a book for nonmembers. Each coupon, properly filled out, entitles the purchaser to one preprint. Mail completed coupons to Preprints, Society of Mining Engineers, 345 E. 47th St., New York 17, N. Y.*

Preparation of Coal for the Electric Utility Market by *James E. Brown, Jr.*—Coal now enjoys the favored position as power plant fuel. This has resulted in the development of a number of single purpose mines producing coal for the utility market. Objectionable characteristics of a coal can be compensated for by boiler design if justified by economics. The utility market is not a quality market, and the emphasis must be on cost. The preparation of coal for the utility market not only embodies the conventional process of preparation but all elements of the production, preparation and transportation of coal that affect the delivered price per million BTU's.

The preparation plants at the two new SEGCO mines of the Southern Electric Generating Co. are described in detail as examples of plants designed expressly for the preparation of power plant fuel. *AIME-ASME Joint Solid Fuel Conference, Birmingham, Ala., October 1961.* **Preprint 61F400.**

Selective Maintenance of Hydraulic Component Parts of Modern Mining Equipment by *L. S. McNickle, Jr.*,—Selective maintenance of hydraulic components on modern mining equipment is a plan which incorporates a mechanic, designated as a hydraulic check mechanic, to periodically check and record the condition of hydraulic component parts. Proper evaluation of the records will allow selection of the machine or component part needing work at a selected time. Lost time

(Continued on page 1025)

Dolomite

the "building blocks" of progress

When Nature adds magnesium to limestone, the result is *dolomite*. In the form of crushed aggregate, it is used for road building, in concrete dams and other engineered construction projects. As crystalline dolomite marble, it is used as ornamental building stone. And because of its magnesia content, it is widely used in making refractories for open-hearth furnaces and Bessemer converters. Found in massive beds throughout the world, dolomitic limestones are truly the building blocks of progress.

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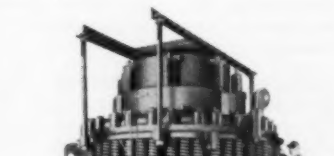

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Mineral Information

An International Directory of Engineering Source Material

Order directly from the publisher all books listed below except those marked • • • The books so marked (• • •) can be purchased through AIME, usually at a discount. Address Irene K. Sharp, AIME Book Dept., 345 E. 47 St., New York 17, N. Y.

Canadian Mines Handbook 1961, *Northern Miner Press Ltd.*, 116 Richmond St. West, Toronto 1, Canada, 1961, 300 pp., $4 paperback, $5.00 hardcover—This edition covers mines of all types including the space age metals—active and producing, profitable and promising—the situation at the moment up to press time. It includes location of head offices and mine offices of the companies listed as well as the officers and directors. Latest figures on earning and production along with holdings, ore reserves, developments, locations, and histories are given. The most recent annual reports and quarterly statements are reviewed. The companies are listed alphabetically and by metals. Also included are 24 pages of maps with producing areas shown in color. • • •

Pipe Friction Manual, 3rd Edition, *The Hydraulic Institute*, 122 E. 42nd St., New York 17, N. Y., 1961, 90 pp., $2.00 U.S., $2.40 foreign—The material in this volume is an extension and rearrangement of the pipe friction data contained in the previous edition and in an earlier publication called, **Tentative Standards of the Hydraulic Institute—Pipe Friction.** The data is based on the latest information available and the form of the manual follows a pattern developed as the result of numerous suggestions from users of the earlier publications. Containing formuli, friction loss moduli, friction factor charts, roughness factor charts, viscosity tables and associated information, this manual provides a most complete and workable treatise on the subject. Wrought iron, steel, and cast iron pipe sizes from ⅛ in. nominal to 84 in. I.D. are covered. Also included are tables of resistant coefficients for valves and fitting, 90 degree bends, diffusers, and other fittings which include the latest available experimental data. • • •

Regions, Resources, and Economic Growth by H.S. Perloff, E.S. Dunn, Jr., E. E. Lampard, and Richard F. Muth, *The Johns Hopkins Press*, Baltimore 18, Md., 1961, 760 pp., $12.00—Although the U.S. has enjoyed a continuing high rate of national economic growth, some parts of the country have grown much faster than others and have drawn people, capital, and materials away from the rest of the nation. Meanwhile, other areas seem fixed in varying stages of stagnation and relative decline. Almost every locality is trying to improve its economy but much of this local effort to attract industry and raise income has been misdirected and will have little effect until it is based on a firm understanding of the large forces at work and the principles of their interaction. This book is a major step toward understanding the causes and pattern of regional economic growth, with special attention to the role of natural resources in this development. The book was sponsored by Resources for the Future Inc. • • •

The 1961 Engineering College Research Review, edited by Paul T. Bryant, *American Society for Engineering Education*, University of Illinois, Urbana, Ill., 1961, $4.00—According to this biennial review, over 11,000 research projects are in progress in 121 leading engineering colleges throughout the U.S. and over 180 million dollars have been spent on research projects during the current year. This survey of engineering college research gives complete titles for all projects under way in schools which hold ECHC membership, the number of persons engaged in research at each institution, and a summary of their research policies. There is a complete index of research project subjects to help in the location of activities in similar fields at different institutions.

American Society for Testing Materials List of Publications, *American Society for Testing Materials*, 1916 Race Street, Philadelphia 3, Pa., 1961, 62 pp., free—This list of publications describes the symposiums, manuals, special publications, indexes, compilation of standards, charts, reference photographs, and reports published by the Society through the years. More than 300 items are described, 40 of which are new and have not been listed previously. • • •

Montana Mining Law by Koehler S. Stout, *Montana Bureau of Mines and Geology*, Room 203-B, Montana School of Mines, Butte Mont., Bull. 22, 1961, $1.75—This publication includes sections on lands subject to location, locating a claim on the public domain, patenting a mining claim, extralateral rights, leasing on federal and state land, mining organizations and safety regulations. Special features are the inclusion of recent mining legislation and sections of the Revised Codes of Montana pertaining to mining. An appendix contains sample legal forms of notice and certificates of lode and placer locations, notice of millsite location, affidavit of annual labor and improvements.

Geologic Map of Pennsylvania, *Bureau of Topographic and Geologic Survey, Department of Internal Affairs*, 1960, $3.75—This full-color map is on a scale of 1:250,000, in two 42 x 58-in. sheets, and may be ordered either folded or rolled. Please place your order with: Division of Documents, 10th and Market Streets, Harrisburg, Pa., and make checks payable to the Commonwealth of Pennsylvania.

Geologic Map of Washington, *State Department of Conservation*, 335 General Administration Bldg., Olympia, Wash., 1961, $3.00—This new colored map is a revision of the earlier geologic map of the state that went out of print in 1956. It is the result of recent mapping by geologists by the State Div. of Mines and Geology in cooperation with USGS, plus a painstaking compilation of information from all available maps showing geology in Washington. The map is on a scale of 1:500,000, a sheet 51 x 76 in., and may be ordered either folded or rolled.

Smoley's Tables, *C. K. Smoley's & Sons Inc.*, P. O. Box 14, Chatauqua, N. Y., 1961, expanded and revised editions of a series of standard handbooks in use since 1901. They include: **Parallel Tables of Logarithms and Squares,** 688 pp., $7.00; **Parallel**

(Continued on page 1025)

NEWS FROM MINE AND MILL

HUNTING TO EXPLORE PAPAGOS RESERVATION

The Department of the Interior has awarded Hunting Geophysical Services a three-year contract to conduct a mineral exploration program over the major portion of the Papagos Reservation in Arizona. This land comprises 4300 square miles southwest of Tucson between the Twin Buttes district to the east and the Ajo area to the west.

The contract allows Hunting to explore all land except certain areas of the reservation which have been withdrawn at the request of the Bureau of Indian Affairs. The company will pay $20,000 to the Papagos Tribe as a cash bonus plus additional sums for rentals and royalties on any future leases. The maximum number of leases Hunting may take is 25, and each lease must be no smaller than 10 acres and no larger than 2560 acres.

Mr. Robert Stebbins, General Manager of Hunting's New York office, informed MINING ENGINEERING that his company has completed arrangements to conduct the exploration on behalf of a joint venture group comprised of individual investors. The program will include geological, geophysical and geochemical studies with the first field crews expected in the area early this fall.

BRADEN'S RANCAGUA OPERATIONS EXPAND

Braden Copper Co., Chile has started a $6 million project to increase productive capacity of the firm's mine, mill and smelter facilities near Rancagua, 65 miles southeast of Santiago.

By modifying and expanding facilities, the crushing, concentrating, smelting and refining capacity is expected to increase to achieve an annual output of 191,200 tons of copper. Kaiser Engineers International will provide engineering, procurement and construction services throughout the program which will be completed by the end of the year.

1960 PRODUCTION FIGURES FOR PENN. ANTHRACITE

Production of Pennsylvania anthracite totaled 18.8 million net tons in 1960, a decline of 9 pct from 1959, according to data submitted by producers to the U.S. Bureau of Mines. However, because of a proportionately greater decrease in shipments of the higher-priced sizes, the industry's revenue fell more abruptly than output.

At the mine, 1960 production was valued at $147.1 million— down 15 pct from 1959—and the average value per net ton dropped from $8.35 to $7.82, the lowest since 1947. The decline in output was primarily attributed to curtailed demand in rail markets outside the region and a sharp drop in exports. Virtually all of the decrease occurred in underground production since the total produced from surface operations was about the same as in 1959.

TVA PURCHASES HUGE COAL RESERVES

The Tennessee Valley Authority, the coal industry's biggest single customer, has exercised its option to buy mineral rights on 59,000 acres of coal land in southeastern Kentucky, and obtained an additional option for coal rights on 53,000 acres in Tennessee. The coal reserves were bought to help assure adequate long-range fuel supply in the eastern part of TVA's system. TVA reportedly has no immediate intention of utilizing these reserves.

KENNECOTT, USW SETTLE BUT ELECTRICIANS STRIKE

Kennecott Copper Corp. finds itself in harmony with the United Steel Workers while discord reigns in its dealings with electricians Local 1081. Negotiations between Kennecott and the U.S.W. over pensions and job evaluation were successfully concluded on Aug. 17. A contract slated to expire June 30, 1962 provides for a 10¢ hourly plus, economic package covering some 2400 workers in the company's Utah and Arizona properties.

But Kennecott has other problems. Electricians Local 1081 at the Bingham pit is striking after disagreement over a new contract. Pickets were set up at the pit while negotiations with the Federal Mediation and Conciliation Service left some 30 unsolved issues as of Aug. 18. Main issues of the dispute revolve around the content of an economic package and job security.

MERGER PLANNED BY CANADIAN MINING FIRMS

Macassa Mines Ltd. and Bicroft Uranium Mines Ltd. are making plans for a merger. The name of the merged company would be Macassa Gold Mines Ltd. The share exchange ratio will be one share of the new company for each share of Macassa and one share for every five shares of Bicroft. The advantage of this merger would be that the new company could use Bicroft's pre-production and development costs and depreciation of the plant and equipment for tax deductions.

INTERIOR DEPT. OFFERS EXPLORATION LOANS

The Department of the Interior officially added gold, silver, iron ore, bismuth, sulfur and tellurium to the list of minerals for which exploration loans can be provided by the Office of Mineral Exploration. However, the Department withdrew a previous proposal which provided that 75 pct instead of 50 pct government participation be allowed for a list of critical commodities, including beryllium, manganese, mercury and tin.

SNYDER MINING CLOSES GODFREY MINE

The economic problems of mining low-grade ore at the Godfrey iron mine near Chisholm, Minn., on the Mesabi Range have caught up with the Snyder Mining Co. The mine was scheduled to close on Aug. 26.

A contributing reason for the shutdown was that competition from other sources of high-grade ore and pellets have greatly diminished market demand for the low-grade product from Godfrey. The Godfrey mine was operated for many years by the Oliver Mining Co. and was reopened by Snyder in 1957. The closing will affect some 160 employees. Snyder Mining Co. operates the Webb-Sellers mine in Hibbing, Minn., the Whiteside mine at Buhl, and has under lease an undeveloped taconite property near Butternut, Wis.

BOL-INCA DREDGE SENT TO BOLIVIA

Bol-Inca Mining Corp. has announced completion of necessary financing to put a dredge on Bolivia's Rio Kaka River and begin production of gold before November of this year. The first dredge was to be shipped by the end of July.

The capacity of Bol-Inca's first dredge will be about one million cu yd of gravel per year. Within one year the company plans to commission on the Daka River a five million cu yd dredge, capable of far greater production, and a significant increase in the Bolivian government tax revenues in 1961.

Bol-Inca's operations in Bolivia are governed by a contract with the government which provides that the Bolivian Government will receive as a base tax, 5 pct of all gold produced, plus an income tax of 5 to 31 pct of gold produced, depending on the richness of the gravel dredged. Since dredging will begin on the richest known gravels, it is expected that tax receipts of the Bolivian Government will be in the upper range of the tax scale almost immediately.

KEYSTONE COAL PLANT MAKING ADDITIONS

A major addition to the coal preparation plant is underway at the Keystone Mine of Eastern Gas and Fuel Associates, at Keystone, McDowell County, W. Va. Designed to improve the quality of both coarse and fine coal for coke-making purposes, the addition is scheduled for completion late this fall.

The first phase, a heavy media washer which replaced a baum jig, went into operation early in July. The second phase, a heavy media cyclone addition to the existing fine coal treating facilities, was scheduled to go into operation around August 1. The new facility also will include froth flotation cells with their associated filtering equipment, large concrete blending bins, and low head drain and rinse screens with centrifugal drying facilities.

ALUMINUM CORPORATION FORMED IN BELGIUM

A new corporation, Aluminium Europe (ALEUROPE), has been created in Brussels, Belgium under the joint sponsorship of the Société Générale de Belgique, a Belgian holding and investment concern, and Reynolds International, Inc. Aluminium Europe will construct a plant in Belgium for the fabrication of aluminum products on a site still to be determined.

The capital stock of the new corporation will be divided equally between the Belgian group and American corporation. The Belgian group consists of the Société Générale de Belgique and three companies in which Société Générale has an interest, namely l'Union Financière et Industrielle Liègoise, Société de Traction et d'Electricité and Cobeal.

N.Y. STATE PREPARING GEOLOGICAL MAP

The State Education Department of New York is compiling data for its first geological map to appear since 1901. All necessary information is expected to be obtained by Sept. 15, and the map is scheduled to be available by early 1962. The map, covering the Niagara, Finger Lakes, Hudson-Mohawk, Adirondacks and lower Hudson area, will sell for an estimated $7.50. Production cost is expected to be about $40,000.

VANADIUM CORP. SIGNS URANIUM CONTRACT

The Atomic Energy Commission has signed a new contract with the Vanadium Corp. of America for the purchase of uranium concentrates to be produced by VCA's uranium processing mill at Durango, Colo. The contract extends through Dec. 31, 1966, replacing a contract set to expire on March 31, 1962.

The contract provides that the U.S. Government will purchase a maximum of 2,306,000 lbs of U_3O_8 in concentrates derived from VCA-controlled mines valued at approximately $18,500,000. In addition, the contract provides for an increase in quantity to cover the purchase of the uranium derived from the treatment of eligible ore from independent producers during this period.

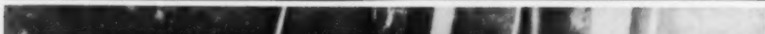
MONROVIA EXPANDS PIER FACILITIES

The Free Port of Monrovia in Liberia started construction July 29 on a major port improvement project to meet the needs of this West African Republic's fast growing economic expansion and its growing exports of iron ore, rubber, latex and palm kernels. Construction of the $1,400,000 pier by the Port Management Co. and Liberia Mining Co. is scheduled for completion in January 1962.

This 855-ft long finger pier will be utilized by Liberia Mining Co. in shipping to world steel markets high-grade iron ore from rich deposits in the Bomi Hills mines 43 miles inland. The pier will accommodate vessels of up to 34-ft draft and will provide a maximum loading capacity of about 2500 long tons of natural fines and concentrates per hour, or 1690 long tons of lump per hour; it can be loaded from either side.

This facility is part of a long-range expansion program by the Monrovia Port Management Co. acting for the Liberian government to keep pace with Liberia's economic development. Two other piers are also under construction in this port: another ore pier to have been completed in August and a petroleum pier which is expected to be completed by November of this year.

The Free Port of Monrovia, first opened to commercial vessels in July 1948, was built originally by the U.S. Government under a $19 million World War II Lend-Lease agreement reached with Liberia in December 1943.



Scene at the one mile level shows, left to right: Morton LaTourrette, Mountain Con foreman; Calvin Gustafson, Larry Lammi, Morris Haninen, members of the shaft-sinking crew; John Suttie, Mountain Con superintendent; and John Hoffman, manager of Anaconda Co. mining operations. The mine has used two-stage hoisting since 1952.

MOUNTAIN CON MINE ONE MILE DOWN

The Anaconda Co.'s Mountain Con mine made Butte mining history in mid-July when it reached a depth of one mile. The vertical shaft of the mine now extends from 6,081 ft at the surface to 801 ft above sea level at the bottom.

The mile depth was reached 97 years after prospectors first discovered gold in Butte, Mont. It was on July 12, 1864 that G. O. Humphreys and William Allison recorded the Missoula claim.

The Mountain Con is one of Butte's oldest mines. It was started about 1876 as a silver producer, but great copper deposits were found not far below the silver. The mine was acquired by The Anaconda Co. in 1895, and by 1899 the shaft was down 2000 ft, deepening at intervals in succeeding years.

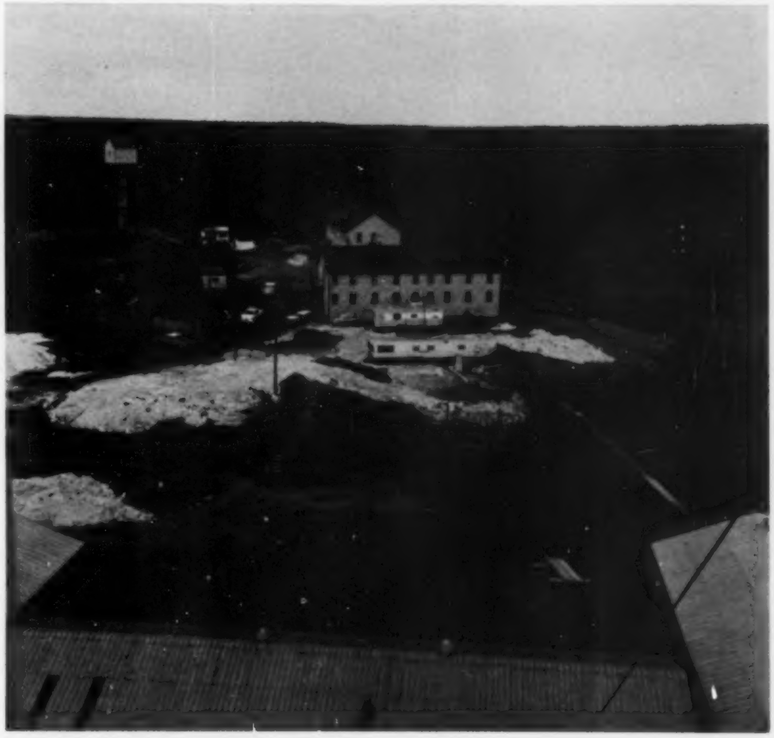
The Con mine which presently employs about 600 men has been an important producer of copper for many decades. Ore in its deep levels is practically the same quality as that found years ago closer to the surface. The recent shaft-sinking is part of Anaconda's plan to prepare for mining of copper ore from deeper levels at Butte.

LARGE BERYL DEPOSITS UNCOVERED IN CANADA

Chemalloy Minerals, Ltd., of Toronto, has discovered huge deposits of previously unrevealed beryl ore, estimated as one of the largest and richest sources of beryllium, at its Bernic Lake mine in Manitoba.

Initial drillings at Chemalloy's mine properties at the Bernic Lake area reportedly have indicated the presence of a minimum of 600,000 tons of beryl ore with beryliferous zones extending beyond the limits thus far explored, suggesting an even greater potential. Preliminary assays indicate that a ton of this beryl yields three lbs of beryllium oxide, representing a probable initial production of 1,800,000 lbs of beryllium's unit salt (BeO) from the zone already outlined.

Because of beryllium's strength and resistance to high temperatures, it is being sought for aerospace, nuclear and electronic applications by scientists of the West in their competition with Soviet rivals. Since North American mines produced only 508 tons of the world's 11,100 tons last year, the U.S. is challenged to find new sources of this metal in areas uninfluenced by Communist, neutralist or ultra-nationalist ideologies. Today, American manufacturers hesitate to invest in developing new applications dependent on "risky" foreign sources of raw materials.



Mine site at Bernic Lake. Beryl and pollucite ore dumps in foreground. Besides the newly discovered deposits of beryl, this area contains the world's largest deposit of pollucite—the only known commercial supply in North America. Pollucite is the main source of cesium, the possible energy source for propelling ion rockets.

PLANT CHRISTENED WITH COCONUT MILK

An electric reduction furnace has been installed by Demag-Elektrometallurgie in Rayagada, Orissa. The ferro-manganese plant was erected in the middle of the jungle about 93 miles from the coast. The furnace, which reached its full capacity on schedule, has a connected load of 7500 kva and produces 15,000 tons of 75 pct ferro-manganese.

Commencement of production was celebrated in a rather curious fashion —the furnace was christened with coconut milk.

GRATON TUNNEL CONTRACT AWARDED

Cerro de Pasco Corp., the subsidiary of Cerro Corp. operating in Peru, has awarded a contract to Morrison-Knudsen Co., Inc. for the driving of the Graton Tunnel. The dual drainage tunnel project at the Casapalca mine in the Peruvian Andes is one of the longest ever undertaken.

The overall project, expected to cost about $8.4 million and requiring about five years to complete, will consist of two parallel tunnels—one for water drainage, the other for ventilation—each about ten by ten ft in cross section and each seven miles long. The tunnels will permit Cerro to mine extensive silver, lead and zinc orebodies in the lower part of the Casapalca mine not now being worked because of underground flooding.

The company plans to drive the tunnel from the portal site at Carbonyacu, about 60 miles east of Lima in the Rimac River Valley, to a point below one of the principal shafts of the Casapalca mine. A vertical connection will then be completed to link mine and tunnel. The project is expected to extend for many years the life of the Casapalca mine, which currently employs more than 900 men.

ASARCO STRIKES SILVER AT GALENA

A vein of silver ore has been uncovered in a heretofore little explored zone of the Galena property in northern Idaho owned by Callahan Mining Corp. and operated by American Smelting & Refining Co. An exploration drift at the 3200 ft level has revealed a downward extension of the vein of high grade ore first disclosed in 1959 on the 3000 ft level.

Work at the 3200 ft level has opened a little over 100 ft of the vein to date, showing silver content per ft of strike length substantially higher than the average content of silver vein developed in the existing workings to the southeast. Callahan's Galena property consists of 1600 acres, of which 1044 acres are leased to Asarco under long-term contract. The strike is located in this leased area.

CALGARY FIRM IN POTASH EXPLORATION

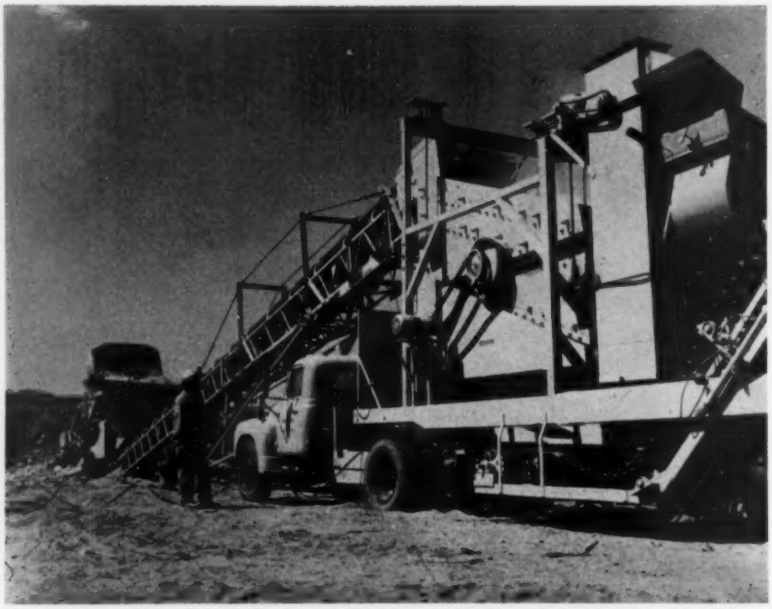
Northwest Company, Ltd., a wholly owned subsidiary of Imperial Oil, Ltd., will carry out potash exploration in Saskatchewan's Findlater and Regina Beach-Lumsden areas. Two permits issued under the subsurface mining regulations cover approximately 200,000 acres.

Since methods have been found to control the water-bearing Blairmore formation located just beyond the rich potash beds in Saskatchewan, two firms are anticipating production there and several others are expected to follow suit.

FLINTKOTE TO BUILD CEMENT PIPE PLANT

The Flintkote Co. has announced plans to start construction this summer of a $10 million asbestos-cement pipe plant in Ravenna, Ohio, 15 miles west of Akron. This is the first of two planned by the company as a result of a licensing agreement between it and the Johns-Manville Corp. under which Flintkote was permitted to make asbestos-cement pipe heretofore marketed by Johns-Manville under the trade name, Transite.

Flintkote products will be merchandised through its Orangeburg Manufacturing Division. The 186,000-sq ft facility will have a 46,000 ton annual capacity.



"DRY DREDGE" TAPS DESERT GOLD

A young Arizona corporation, United Placer Industries, Inc., is presently mining gold from arid desert placer deposits by a unique process.

Placer gold can be recovered by either wet or dry processes, but outside the laboratory it is commonly achieved by washing the gravels. The problem with dry separation is that even the low moisture content of deposits found in desert areas is sufficient to cause the tiny flake-gold particles to adhere to gangue. However, a unique "dry land placer mining dredge" is at work on extensive dry placers in the San Domingo and Weaver areas about 50 miles northwest of Phoenix, Ariz. These properties have been assayed at $1 billion by the U.S. Bureau of Mines.

United Placer Industries, Inc. has just christened its first production model of the machine, "Geraldine" after Mrs. C. Geraldine Freund of Chicago, President of the company. The "dredge", which stands 18 ft high, is mounted on a trailor-truck platform. Placer gravel is dumped into a huge hopper where the coarse material is stopped on the grizzly and the finer sizes elevated by conveyor to the head end of the "dredge" unit. Graduated vibrating screens deliver two fractions, minus 10-mesh, and minus-¼, plus 10-mesh, all coarser material being rejected. The screen product is lifted by drag conveyor enclosed with a battery of butane-fired infrared heating units. The heat releases moisture from the particles which are evaporated by blowing with dry air. Moisture content is reduced from about eight pct to three or four pct. The dried sand is dropped onto six electro-static separator tables.

The separation is achieved by a blower which passes a continuous stream of air over the tables. The air partially fluidizes the bed of sand and the contained gold particles receive an electrostatic charge which causes them to adhere to the table fabric. The tables are inclined and made up in stepped units (see photo below) with a riffle at the edge of each unit to retain the accumulating gold. The gold, said to be about 90 to 95 pct pure, is then picked up by suction.

"Geraldine" treats 50 to 75 cu yd per hr, is powered by a 60-kw portable diesel generator, consumes 10 to 12 gph of butane for the infrared heaters and is operated by a two-man crew. The process is said to treat gravel at a cost of approximately 45 to 55¢ per cu yd.

United Placer has patents pending on the process which was developed over a period of five years by Kelsey Boltz and Donald W. Wright who are now officers of the company. The firm has leases on 25,000 acres of placer claims which are said to contain one billion yds. Plans are being made to build larger units of 500 to 1000 cu yd per hr capacities which the company expects will operate at lower cost (a cost of 25¢ per cu yd is anticipated).

Operating a prototype unit at the property to test the gravels, the company reports the gold content of the sands from 30¢ to $3.00 per yd.

Electrostatic table surface shown here is cloth fabric. Air passed through cloth transmits electrostatic charge to gold particles which accumulate behind riffles. Gangue sands pass off inclined surface.

INCREASING INTEREST IN UTAH POTASH

Following withdrawal of rich potash deposits near Moab, Utah from oil and gas leasing (see MINING ENGINEERING, August, 1961, p. 947), several companies have reflected interest in the property in and around what is called the Seven-Mile area.

Construction of a 3,000-ft deep shaft has started at Cane Creek, and plans for construction of an 8,000 tpd potash plant have been completed. The Texas Gulf Sulphur Co. is building the plant, with an initial expenditure of about $25 million. In addition, the Denver & Rio Grande Western Railroad has started construction of a 36-mile industrial spur from the main rail line at Crescent Junction, Utah, to the mill site at Cane Creek via the Seven-Mile area.

A further reflection of interest in the recently-opened potash lands is an agreement signed by Continental Oil Co. by which it will explore for potash on leases and permits held by Sawyer Petroleum Co. and associates. This involves some 8000 acres of potash permits and leases on the Crescent Graben structure located in Grand County, and surrounds the Defense Plant Discovery well drilled by the government in 1942. If test drilling shows promise, Continental will start large-scale production.

Crescent Graben is located one mile west of Crescent Junction on the main line of Denver & Rio Grand Western Railroad and is some 30 miles north of Cane Creek.

TWO MINING FIRMS MERGE IN NEW MEXICO URANIUM

The Homestake Mining Co. and The Sabre-Pinon Corp. are planning to combine their uranium interests in New Mexico's Ambrosia Lake district. The agreement is pending further negotiations concerning the status of limited partners and a prospective Atomic Energy Commission contract extending through 1966.

Until the end of the AEC contract in 1966, Homestake will have a 35 pct interest, Sabre-Pinon, 65 pct. At that time, Sabre-Pinon will pay Homestake an undisclosed amount at a reported 10 pct interest, and thus alter the ownership percentage to 25 pct for Homestake and 75 pct for Sabre-Pinon.

BOOKS

(Continued from page 1020)

Tables of Slopes and Rises, 532 pp., $7.00; **Segmental Functions,** 436 pp., $6.00; **Five Decimal Logarithmic Trigonometric Tables,** 200 pp., hardcover $2.00, paperbound $1.00; **Three Combined Tables,** 1124 pp., $12.00 and **Four Combined Tables,** 1425 pp., $14.00.

Planning, Policy Making and Research Activities—U.S. Department of the Interior, *Resources for the Future,* 1775 Massachusetts Ave., N.W., Washington 6, D. C., 1961, 44 pp., 50¢—This staff report, made at the request of Secretary of the Interior Stewart L. Udall, deals solely with resources aspects of the Department's work and is concerned primarily with the role of the Secretary and other presidentially appointed officials in developing and coordinating research, planning and policy making. As background to the analysis, the report includes a brief survey of natural resources problems of the 1960's.

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U.S. GEOLOGICAL SURVEY

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Bull. 1087-H Geology of the Clay Hills Area, San Juan County, Utah.
Bull. 1089-A Geology of the Alvord Mountain Quadrangle, San Bernardino County, Calif., $1.00.

ABSTRACTS

(Continued from page 1017)

on production shifts is greatly minimized by a complete awareness of the condition of all component parts and the ability to select, for change out, parts which are indicated as weak or potentially faulty.

Selective maintenance allows the outside rebuild shop to keep ahead of the mine's demands by having a clear record of component part decline. Work may be scheduled to meet record-indicated potential needs. Engineering provides the evaluation and direction phases of selective maintenance. Records show the items needing attention and indicate the value of past and current revisions.

Selective maintenance depends on the efforts of many individuals. It develops a sense of awareness, a feeling of participation, which encourages a maintenance man to exert the added effort to produce a unified plan. *AIME-ASME Joint Solid Fuels Conference, Birmingham, Ala., October 1961.* **Preprint 61F402.**

An Application of Digital Computers to Mining System Analysis by *Robert W. Bouman* and *Robert L. Frantz*—A method of simulating a mining operation with a digital computer program for the purpose of optimizing the mining system has been devised. A particular mining system is analyzed and the digital computer program needed for simulation are described. One of the variables in this mining system is varied and its effect on the cost of mining is predicted with the aid of the simulation programs. *AIME-ASME Joint Solid Fuels Conference, Birmingham, Ala., October 1961.*

Production of Lightweight Aggregate from Washery Refuse by *J. W. Myers, J. J. Pfeiffer,* and *A. A. Orning*—This paper presents the results of an investigation on preparing lightweight aggregate from coal washery refuse. Two samples of refuse containing about 40 and 55 pct combustible material, but having widely differing ash-fusion characteristics were pelletized and burned on a chain-grate stoker to produce a sintered material low in carbon content and of satisfactory size consist.

The effects of air rate and distribution, stoker operating conditions, furnace wall temperature and moisture content of the refuse are discussed. The importance of controlling the particle size distribution of the material fed to the stoker is emphasized. The difficulties encountered during the study indicated that considerable development work on the pelletizing process would be required to obtain satisfactory results with some types of refuse. The use of preheated air or a fluxing agent to aid in sintering the more refractive mineral matter was considered. Data obtained during the investigation was used in designing and constructing a successful commercial plant for making aggregate from one of the types of refuse tested. *AIME-ASME Joint Solid Fuels Conference, Birmingham, Ala., October 1961.* **Preprint 61F403.**

Remaining Coal Resources of a Part of the Southern Appalachian Field by *Reynold Q. Shotts*—From published sources on various bases, remaining recoverable reserves of bituminous coal lying in beds 28 inches or more thick, and as of Jan. 1, 1958, have been calculated or adopted. For part of Alabama, selected Kentucky and Virginia counties and Tennessee the figures are also given on a county basis. The total quantity of coal, the proportion in beds 42 inches or thicker and the anticipated life of the reserves at 1955-57 production rates, are discussed. The possible relation between production rate and size of reserve and the conservatism of the estimates are discussed. It is concluded that the area should contain reserves sufficient for about 200 years at 1955-57 rates of production. *AIME-ASME Joint Solid Fuels Conference, Birmingham, Ala., October 1961.* **Preprint 61F401.**

Preparation of Coal for the Metallurgical Market by *J. L. McQuade* and *C. B. Taylor*—This is a new, unique and novel way to clean the Sewell seam of coal to eliminate degradation and prevent stream pollution. The plant uses deister tables and a Chance Cone but the new feature is a pneumatic sampler to remove dry coal from 48 mesh to 0. This pneumatic sampler also has a cleaning effect since it does not tend to pick up heavy particles of either slate or pyritic sulfur. Large horizontal filters are used to dry the coal ahead of a thermal dryer, which cuts down on degradation. *AIME-ASME Joint Solid Fuels Conference, Birmingham, Ala., October 1961.* **Preprint 61F401.**

PRODUCTS
FOR MINE AND MILL

Slurry Pump

The Kemlon Pump Model 150-7, made by *Keystone Engineering Co.* is a diaphragm-type unit specifically intended for handling corrosive slurries at pressures up to 3000 psi. This pump has a barrier diaphragm which separates all the working parts from the fluid handled, and it employs an actuating fluid between the piston and diaphragm without mechanical linkage of any kind. All surfaces of the pump which contract corrosive media are of Teflon and inert metals. The standard 25-hp Simplex Model sells for $2785. **Circle No. 76.**

Transistorized Two-Way Radio

General Electric's Communication Products Department has introduced a new mobile two-way radio which is reportedly the first transistorized unit to provide dual frequency listening through a common receiver, thus minimizing extra battery drain. The transmitter-receiver contains the "front-end" portion only of the second receiver. The RF amplifier and oscillator output of the second receiver is connected to the first receiver's high IF amplifier input. This unit is especially applicable to such industries where there is need to listen to two separate intra-company dispatching systems utilizing different frequencies. **Circle No. 77.**

Scalping Screen

A single-deck scalping screen, designed by *Allis-Chalmers*, has a curved discharge end section to feed over-size stone, coal or ore directly into a crusher or breaker. Named "Ripl-Flo", the 8x14-ft floor-mounted, rubber air-spring supported screen can process 1300 tph of 8-in. x 0 run-of-mine coal. The screen

shown above has 6-in. openings, 22½° slope and operates at ⅜ in. amplitude at a speed of 900 rpm. **Circle No. 78.**

Strato-Tower

The *Equipment Division* of *Young Spring & Wire Corp.* is marketing their Strato-Tower, a truck-mounted boom apparatus which can raise men and/or materials to high elevations. The D-type unit shown below is available in 35, 40, 45, 50, 60, 65 and 101-ft sizes. Mounted on the back of the truck, it leaves the truck bed open for other types of equipment. All models are easily detached from the truck for parking or storage, or for use of the truck in other work. The D-type offers an option of outriggers equipped with rubber wheels on units up to 65 ft high that enable movement of the tower while it is elevated. Two folding outriggers with a 14-ft span and steel pads are standard on units up to 50 ft. Units over

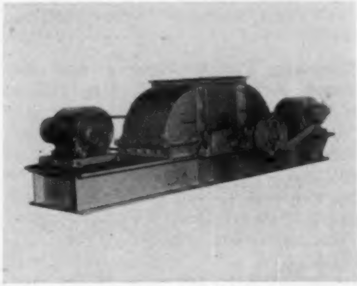
60 ft and all heavy duty models have three folding outriggers with an 18-ft span and steel pads as standard equipment. **Circle No. 79.**

Mine Cave-In Detector

A new type of safety indicator for use with tunnel roof anchor bolts to give indication of imminent mine cave-ins has been developed by *Ladd & Little, Inc.* When rock strata shifts, the tie bolts used for roof support do not sag noticeably and thus give no warning as do timber beams and props. As a result, there is practically no advance indication of dangerous stress conditions before the bolts actually break. The device offered is designed to give warning of dangerous stress on a mine tunnel roof anchor bolt. This is done by use of a washer, a shoe and a two-ft long indicator flag of aluminum. When the flag droops because of undue stress in the bolt, it is visually noticeable in the area so that action can be taken to shore up the roof or evacuate the tunnel. **Circle No. 80.**

Crusher For Wet Clay and Shale

The Twin-Rotor impact crusher offered by the *Pennsylvania Crusher Division* of *Bath Iron Works Corp.* has been designed to eliminate plugging and caking which often occur in the fine reduction of wet and sticky materials. The machine has no cage bars or grates to plug, and wear liners are offset from the frame so that gas torches can be played into the spaces between liners and frame.



Such heating of the liners prevents wet material from adhering to them, thus eliminating machine shutdown for scraping off caked matter. **Circle No. 81.**

Water Level Safety Switch

A water level safety switch designed to prevent pump damage due to insufficient liquid at the source, or when pump loses its prime, has been developed by *U.S. Gauge Division, American Machine & Metals, Inc.* This switch is suitable for installations where bearings, packing glands and motor windings depend on pumped water for lubrication and cooling. This device senses liquid flow by measurement of discharge pressure and automatically shuts down system when water level gets too low. The safety switch mounts on the pump discharge line and is connected in series with the pump motor power supply. If after a predetermined period of time, pump discharge is not at a specified pressure level, a microswitch electrically disconnects the pump motor, stopping the system. At frequent intervals, automatic cycling of the pump will be initiated until the required conditions are satisfied by the flow capacity of the system. **Circle No. 82.**

Radiometric Assay System

Electronic Association Ltd. has developed an underground radiometric assay system designated EA-UA-1. The unit reportedly combines precise counting, high sensitivity, extreme stability and large count capacity necessary to make fast, accurate, on-the-spot assays possible. The unit can note very small and gradual changes in ore grade, and it is designed to eliminate confusing background effects. Two measurements are possible: beta plus gamma count and a gamma count only. The detector head is designed to record the beta count coming from ore in the rock face located in front of the window of the head. **Circle No. 83.**

(Continued on page 1029)

for more information

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9 **MINING ENGINEERING** Not good after December 15, 1961

Students should write direct to manufacturers.

1	2	3	4	5	6	7	8	9	10
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Name ______________________ Title __________

Company ______________________________

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City and Zone ____________________ State __________

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9 **MINING ENGINEERING** Not good after December 15, 1961

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Name ______________________ Title __________

Company ______________________________

Street ________________________________

City and Zone ____________________ State __________

for more information

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► "PRODUCTS FOR MINE AND MILL"

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P. O. BOX 8073

PHILADELPHIA 1, PA.

Advertised Products

"Products for Mine and Mill"

"Data for Mine and Mill"

(Continued from page 1026)

Rotary Rock Bit

For blast-hole drilling in mines and quarries, the VQM three-cone rotary rock bit in 8¾ and 9-in. diam sizes has been developed by *Varel Manufacturing Co.* The bit has been designed with larger bearings which

allow increased weights when drilling harder sections. The teeth of these cones are almost square in shape, thus maintaining more cross-sectional area at the end of the tooth during its life time. **Circle No. 84.**

Cutting Torch Oxygen Valve

The Harris Calorific Co. has developed a cutting oxygen valve (Model No. E-97-C) which provides unrestricted full flow with a ¾ turn. This valve will be included in the company's complete line of machine cutting torches. These valves are designed with a quadruple thread for fast action and smooth control of the oxygen cutting jet. Owners of Harris torches can order these valves for equipment conversion. **Circle No. 85.**

Pneumatic Feeder

National Air Vibrator Co. has announced Model NFT 4-840 tubular pneumatic feeder which has a 8-in. diam tube, is 40 in. long and uses an air vibrator which consumes only 16 cfm at 50 psi. Featuring a one-piece vibrator design with a silent vibrator piston as the only moving part, this feeder can be furnished in carbon steel, stainless or aluminum. A wide range of flow rates can be obtained by varying the air pressure range from 20 to 70 psi, thus varying the vibration rate. **Circle No. 86.**

Water Sampler

Princeton Division of *Curtiss-Wright Corp.* is now marketing their Aquator, a water sampler which permits continuous monitoring of a water body. Composed of an adjustable float and a collecting chamber which is submerged in the water, the unit slowly collects water at a fixed rate (about two quarts in 24 hours). Designed to give a more accurate proof of the absence or presence of industrial wastes, this unit eliminates the criticism of tests run on random samples of water. **Circle No. 87.**

Crusher For Fibrous Pipe

A crusher with special feeding mechanism has been developed by *McLanahan Corp.* for reducing asbestos-cement pipe and other fibrous materials. This modification of a standard single roll crusher was made to accommodate a wide range of sizes of pipe, from 3 in. to 16 in. in diam, and some as long as 13 ft with wall thicknesses up to 2 in. This crusher is used as part of a closed circuit system which reduces imperfect pipe and discharges approximately 4 x 6-in. pieces for further reduction in secondary crushers. The unit has a modified single roll crusher and a special feed chute to allow the pipe to slide into the crusher. According to the manufacturer, this crusher with modifications of the feed mechanism can be used for reducing other reject scrap materials in addition to fibrous pipe. **Circle No. 88.**

Steep-Angled Mine Conveyor

The Royal Adam Tanning and Belt Co. (Netherlands) has developed a cleated conveyor belt with angles ranging to at least 35° and up to 45°. This conveyor belt has been installed in a number of European coal mines, and the company is now introducing

the belt to the American market for use in gravel and sand pits and coal mines. The belt has rubber cleats ½ in. high and ½ in. wide. These "Chevron" belts are available in widths of 16, 20, 24, 28, 32 and 48 in. **Circle No. 89.**

Vibrating Grinding Mill Redesigned

Redesign of its synchronized dual drive vibrating grinding mill for easier maintenance has been announced by *Allis-Chalmers.* Now available with 15, 36 and 42-in. chambers, the mill's vibrating mechanism has been relocated from the grinding chamber's interior to positions adjacent to the chamber, thereby eliminating the need for bearings within the chamber. The rearrangement has resulted in improved wearing parts for increased user economy, simplicity and maintenance accessibility. This grinding mill is reportedly capable of out-producing a tumbling mill 15 to 30 times per unit volume. **Circle No. 90.**

Clay Breaker

A clay breaker designed for continuous chopping of clay and ore feed in processing systems, has been introduced by *McLanahan Corp.* Constructed to fit under a feed hopper, the clay breaker continuously receives feed from the hopper and cleaves it between a series of meshing paddles on each of two paddle shafts. The paddle action further keeps the feed agitated to provide a uniform flow of broken material from machine to conveyor. This machine can be custom-built to almost any specifications. **Circle No. 91.**

Transits

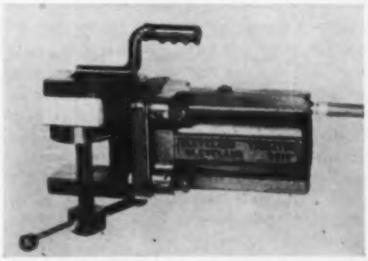
To meet the requirements of engineers and surveyors who have expressed a preference for working with upright images, *Wild Heerbrugg Instruments, Inc.* has made this feature available on a number of its basic instruments. Both the T-1A optical repeating transit and T-16 optical transit are offered with this feature. To differentiate these from the internationally standard inverted image instruments, they have been designated as T-1AE and T-16E. **Circle No. 92.**

Adjustable Gantry

A four-ton capacity gantry that folds compactly for convenient storage has been developed by *B. E. Wallace Products Corp.* The Magic-Pole Universal gantry can be quickly dismantled by removing its caster frames, closing its telescoping legs and folding them against an I-beam It may also be lowered and narrowed for rolling under fire doors, into elevators and through tight aisles. The telescoping legs adjust separately to allow the gantry to be set up on different levels, such as loading platforms and truck beds. **Circle No. 93.**

Portable Vibrator

The Cleveland Vibrator Co. has developed a lightweight (70 lbs) vibrator for all applications which require occasional vibration. Designated LSKO-VG, this portable air-powered vibrator has a vise to attach



it to concrete forms, foundry core boxes, bins or other objects up to four in. thick. This unit can develop a force of over 1000 lbs, and reportedly can operate on as little as 30 psig of air. Both intensity and frequency of vibration can be regulated by adjusting the air supply to the vibrator. **Circle No. 94.**

DATA

FOR MINE AND MILL

SERVICE TO THE MINERALS INDUSTRY: *Arthur D. Little, Inc.* is inaugurating a service for the minerals industry. This service will consist of two phases: field consulting and quarterly reports on the industry. Under the field consulting service, the consulting firm will work with clients as specific problems arise and will provide advice on present or contemplated operations and processes, applications of new techniques, new developments in the minerals and metals markets and significant technical and economic aspects of the industry. The quarterly reports will discuss technical, economic and marketing problems in the industry. For further details **write direct** on company letterhead for the booklet "Service to the Mining Industry." Address: Arthur D. Little, Inc., 314 Battery St., San Francisco, Calif.

(102) TORQUE CONVERTERS: A 24-page bulletin, "Why a Torque Converter is Standard Equipment in the Eimco Tractor Unique Power Train," has been issued by *The Eimco Corp.* The booklet defines the concept of torque and shows how a torque converter functions. A good number of comparisons are made between Eimco design and that of other manufacturers. Some of these include: the company's Unidrive powershift transmission engineered for a single stage torque converter compared to conventional gear-shift drive; fuel consumption and economy figures; cost and operating data; and closed circuit hydraulic system versus fuel oil hydraulic systems.

(103) AIR POLLUTION CONTROL: Modern techniques and equipment for air pollution control are presented in a 12-page, illustrated brochure (Bulletin 500) published by *Research-Cottrell, Inc.* Recent installations of gas cleaning equipment in oxygen steel plants, paper mills, electric utilities, cement and chemical plants are given. Research, laboratory, testing and service facilities available to customers are also listed and described.

(104) DUST FILTER: An eight-page bulletin describing the RJ dust filter has been issued by *The Day Co.* Installations of the filter are pictured and described, and dimensions and specifications of single and multiple units are given.

(105) TELEPHONE-LOUD SPEAKER: For use in mines, factories, refineries, mills and other locations, a combination telephone and loud speaker is described and illustrated in a bulletin (No. 1600-1) available from *Mine Safety Appliances Co.* The transistorized Pager is self-contained and utilizes existing interplant or mine telephone lines. The unit is individually powered by two dry cell batteries that are employed only when the telephone-loud speaker is in use. Ten or more units can be installed on a single line.

(106) VIBRATING SCREENS: *Syntron Co.* has published a 32-page bulletin on the company's line of vibrating screens. Rotary vibrator screens, grizzly bar screens, screening feeders, mechanical conveyor screens and pulsating magnet screens are illustrated and described in detail.

(107) CUTTING EDGES AND END BITS: A 24-page catalog (212-A) covering cutting edges, end bits and router bits has been issued by *Esco Corp.* The publication includes reference tables for all major makes of graders, dozers and scrapers, plus the company's cutting hardware that is available for them.

(108) LIQUID LOADERS: A 28-page catalog by *OPW-Jordan* illustrates and describes the basic types of liquid loaders available for loading or unloading bulk fluids. The bulletin describes the seven basic types available: slide sleeve, long range, scissors arm with valve inboard or outboard, single arm, utility or bottom loading. Complete engineering and technical information is also provided.

(109) RUST REMOVER: ACIGEL, a new type of rust remover composed of a multi-acid material which removes rust to bare metal by chemical action is described in a bulletin issued by *Sloan Chemicals, Inc.* This solution replaces such manual methods as wirebrushing, blast cleaning and flame cleaning.

(101) CAREERS IN THE MINERAL INDUSTRY: "Opportunities Unlimited", a booklet designed to introduce high school and college students to the various careers available in the extractive industry, may now be obtained from the Society of Mining Engineers of AIME. Describing the various aspects of the industry, from exploration to mineral beneficiation, the booklet also discusses such subjects as secondary and college training, selecting a college, the cost of a college education, and the opportunities awaiting a new graduate in mineral engineering.

(110) SLURRY SYSTEMS: The Qualicon series of liquid density gauges which provide continuous measurement of the density of a solution or slurry directly in a process pipe without contacting the material or moving parts, is described in a six-page bulletin by *Nuclear-Chicago Corp.* These gauges reportedly increase operation efficiency of many diversified processes, decrease man-power and improve product quality through continuous measurement for control of process variables. Applications include: detection of pipe line interfaces in the petroleum industry; control of acid concentration in the chemical industry; and solids control of thickener underflow in the mining industry.

(111) LIGHTWEIGHT SLUSHER: A slusher, developed for South African mining and now available in the U.S. and Canada, is described in a data sheet issued by *International Machinery Co.* The Pillman slusher, featuring a multiple steel disc clutch, eliminates the use of external brake and clutch bands. The unit also features low weight and high rope pull per given hp. All-welded steel construction, case-hardened gears and the absence of external moving parts considerably reduce maintenance problems.

(112) SOIL EXPLORATION KIT: A soil exploration kit which contains a variety of hand-operated soil sampling tools for use in recovering samples of most overburden materials from depths of 20 ft is illustrated in a data sheet issued by *Penndrill Manufacturing Division, Pennsylvania Drilling Co.* The equipment is supplied in a standard metal box or in a canvas tool roll.

(Continued on page 1032)

For more information about the Joint Meeting of the
Industrial Minerals Divisions of CIM and SME
being held in Ottawa, Ontario on October 1 to 3,
fill in your name and address on Reader Service Card
and circle **No. 100.**

(Continued from page 1030)

(113) HOSE FITTINGS: Iron Mike, a new type of detachable, reusable fitting for high pressure hose assemblies, is described in a bulletin by *Aeroquip Corp.* Designed especially for industrial markets such as construction equipment and heavy automated machinery, the fitting is recommended for a wide range of high pressure hydraulic and pneumatic applications as well as for fuel and lubrication systems.

(114) ORAL RESUSCITATOR: Venti-Breather, a simple and economical oral resuscitator that eliminates mouth-to-mouth contact in rescue breathing, is illustrated and described in new literature available from *Mine Safety Appliances Co.* The unit consists of a mouthpiece, breather tube, one-way valve and flexible face mask.

(115) HORIZONTAL VIBRATORY SCREENS: An eight-page bulletin describing a line of horizontal vibratory screens and conveyors has been released by *Comco Corp.* The bulletin illustrates the company's true balanced-mass design and point-of-no-oscillation suspension with photos and drawings. A special section describes the screen's positive, self-adjusting eccentric drive.

(116) CHAINS AND ATTACHMENTS: An illustrative folder (DH-138), published by *American Chain Division, American Chain & Cable Co., Inc.*, features the company's winch line tail chain. This chain is an assembly of several links of either high-test or alloy chain with drop forged, alloy steel hook, heat treated for extra durability. The winch line tail chain provides a flexible member for the ends of wire rope lines such as winch lines, thus adding to the usefulness of wire rope in lifting, loading or skidding machinery or other heavy loads. Other chains are also described in the folder.

(117) TRAILERS AND TRACTORS: A brochure prepared by *Athey Products Corp.* describes the firm's new line of T-Line trailers. It shows how these trailers and tractors are able to reduce hauling costs per yard by providing bigger payloads, higher speeds and greater power. Six new T-Line trailers are described in the brochure, each designed and built for specific hauling jobs in the earthmoving, mining, quarry and coal hauling fields.

PORPHYRY COPPERS by A. B. Parsons and **ORE DEPOSITS OF THE WESTERN STATES,** by W. Lindgren, two extremely popular volumes published by AIME, are now out of print. For information on possible new editions of these publications, see the Secretary's Letter on page 1078.

(118) DRY PROCESSING EQUIPMENT: An eight-page bulletin of their dry processing equipment has been made available by *Sturtevant Mill Co.* The bulletin includes information on crushers, grinders, pulverizers, micron-grinders, air classifiers, granulators, feeders, screens, elevators, conveyors and mechanical dens and excavators.

(119) THICKENERS: A 24-page brochure (Bulletin No. 3002) describes the complete line of *Dorr-Oliver* thickeners for chemical, metallurgical and industrial processing. The brochure describes the standard sizes and specifications for the thickener designs and mechanisms. Single and multiple compartment thickeners having both center-drive and perimeter-drive rakes in a variety of configurations for unit operations in all the process industries are described.

(120) MINE RESCUE EQUIPMENT: A self-contained oxygen breathing apparatus for rescue work, and a transistorized communication system are described in a bulletin available from *Mine Safety Appliances Co.* The two-hour breathing apparatus with a mouthpiece-type mask supplies respiratory protection in poisonous or oxygen-deficient atmospheres. The unit features an oxygen admission valve that automatically meets the wearer's exertion requirements, a positive pressure circulatory system, a Cardoxide absorbent and a one-piece, leakproof cooler and regenerator. The battery-powered portable communication system includes microphones, amplifiers, loudspeakers, 500-ft reels of two-conductor wire and a two-conductor guide line.

(121) SYNTRON CONDENSED CATALOG: A condensed catalog of vibratory materials handling equipment, vibrating parts handling equipment, mechanical shaft seals, paper joggers, portable power tools and power rectification equipment has been published by *Syntron Co.* Catalog No. 616 contains illustrations, descriptions, data and specifications on all of the company's products as well as a listing of Syntron representatives.

"HOW TO SELECT INDUSTRIAL LOCOMOTIVES": Issued by *Plymouth Locomotive Works*, this report is designed for all users and prospective users of industrial locomotives who realize that timing, capacity and general efficiency of haulage equipment may determine the margin of profit of a particular operation. Among the subjects treated are such basic locomotive selection factors as rail size, road beds, rail capacity and gauge. Such specific problems as grades, grade resistance, curves and curve resistance are explained. Typical examples, as well as simple tables, are used to clarify the more technical points.

(122) DRILLING RIGS: Bulletins LRD-2 and LRD-3 describing blast hole drilling rigs for holes from 2½ to 7⅜ in. have been issued by *Le Roi Division* of *Westinghouse Air Brake Co.* These drilling rigs operate through a mechanical drive and can be truck, crawler or wheel-mounted. The LRD-3 is a top drive machine designed to drill to 100 ft; the lighter LRD-2 drills to 30 ft in a single pass with direct drive through the rotary table.

(123) ELECTRONIC AIR CLEANERS: A line of heavy-duty electronic air cleaners with push-button control is described in Catalog 1435 available from the *Westinghouse Electric Corp.* Featuring the company's PD Precipitron electronic air cleaners, sections of the booklet are devoted to the principles of electronic air cleaning, construction features of the heavy-duty Precipitron with dual header washing, selection data and details on specific application arrangements.

U.S. ENERGY PRODUCTION AND CONSUMPTION: "Energy Production and Consumption in the United States: an Analytical Study Based on 1954 Data," a statistical study supported by the *U.S. Bureau of Mines* and *Resources for the Future, Inc.* has been published as "Report of Investigations 5821." The 156-page report presents a set of detailed energy-flow tables including all forms of energy. These tables trace, in conventional units and Btu's, the origin and disposition of each energy-bearing material in the U.S. in 1954, within the framework of a uniform and detailed accounting system. **Write directly** to *Resources For the Future, Inc.*, 1775 Massachusetts Ave., Washington 6, D. C.

New Films

"What Kind of Pipe Should I Buy?" is the title of a film on polyethylene pipe released by *Allied Chemical's Plastics Division.* The film answers common questions asked by persons interested in polyethylene for cold water piping. Sources of confusion on such matters as density, standards, test, costs and safe materials are covered in understandable terms. The 14-minute film presents the story of polyethylene pipe as a conversation between a consumer and a pipe authority. Write to: William A. Means, Product News Section, Allied Chemical Corp., 40 Rector St., New York 6, N. Y.

The *KW-Dart Truck Co.* has produced a 16mm film focusing attention on the way their 55T truck's triple-reduction planetary drive axles absorb road shock. The film is available to mining and construction companies upon request. Write on your firm's letterhead to K-W Dart Truck Co., 1301 North Manchester Trafficway, Kansas City 20, Mo.

African Iron Ore Generates International Bidding

Huge resources of iron ore in Liberia and Guinea are receiving a great deal of attention from financial interests throughout the world. Two of these deposits, located in the Nimba mountain range, are already committed to developers through concession agreements. The orebodies in the Liberian and Guinea sections of the Nimba Range each contain an estimated 250 million tons of ore. A third orebody, 60 miles long, known as Simandoa, is still uncommitted although bidding on this property has been going on for more than a year. The Simandoa deposit has an estimated reserve of 750 million tons. (News of Liberia's expanding iron ore pier facilities in the port of Monrovia appears on page 1022).

U.S. Firm Acquires Interest in Chilean Mining Co.

Minerals & Chemicals Philipp Corp. has acquired a major interest in Compania Minera Santa Fe, a Chilean mining company which owns and operates large iron ore mines at several locations in Northern Chile. In addition to its developed properties, the Santa Fe company has mineral rights which, upon further exploration, may prove to contain one of the largest ore reserves in the South American continent. The transaction also involves the acquisition of a major interest in the shipping company engaged in transporting iron ore from these mines to different parts of the world.

Chile Plans To Demand U.S. Production Increase

Enrique Serrano, Chile's Minister of Mines, has made a proposal to his government's legislature which would require U. S. mining interests in that country to increase production by 15% every three years and to refine in Chile at least 90% of copper mined there. Presently, U. S. mining firms refine somewhat more than 50% of their combined Chilean copper output. Currently, three U. S. firms are planning expansion in Chile: Kennecott plans a $200 million expansion program at its Braden El Teniente property; Anaconda is planning a copper refinery at Chanaral which would cost an estimated $15 million to $18 million; and Cerro Corp. has announced plans to develop the Rio Blanco orebody at an initial outlay of about $95 million. Whether Sr. Serrano's proposal will have any adverse effect on these plans is not yet certain. The proposal will be ready for voting during the present session of the congress. Following shortly after the proposal was a legislative approval of a bill adding 5% to income taxes paid by U. S. mining interests in Chile. (See Drift, page 1049.)

India Receives World Bank Loan To Increase Coal Production

The World Bank has made a loan equivalent to $35 million to India to help the private coal mining industry expand production under the country's third Five-Year Plan. Under the plan, India's coal needs will rise to 80% above present output, from 54.6 million to 97 million tons in 1966. Private companies intend to expand existing facilities and open new mines to increase their annual production from 44 million to 61 million tons. The loan will give India the foreign exchange required for importing equipment for this expansion, but it is expected that private companies will be able to provide the rupee financing for the $116 million program.

USSR Negotiates with Chile for Small Mine Production

Chile made mining news again recently when the Soviet Union and representatives of small and medium-sized mining companies in Chile were negotiating a five or six-year copper contract. The contract would call for a maximum of 60,000 tons of copper per year (60% semi-processed, 40% ingots) to be sold to Russia on a cash basis. No conclusion has been reached as yet.

Standard Beryllium's Mill to Boost Brazil's Beryl Production

Standard Beryllium Corp.'s $350,000 Boa Vista flotation mill, construction of which began in mid-August, is expected to greatly increase the company's production of beryl in Brazil. The mill, which will use the Van Dornick process, will concentrate an estimated 100,000 tons of feed material annually to produce 2500 tons of beryl ore. The ore to be milled assays about 2.5% beryl containing 12% BeO.

World's Steel Production for First Half Declines Four Pct

World steel production in the first half of 1961 totaled 182 million tons, representing a 4% decline from the 189 million ton mark recorded in the corresponding period of a year ago. U. S. output for this period was 45 million tons, 16 million tons below the figure for the first half of 1960. The U. S. decline is attributed to the fact that early 1960 was the post-strike period of unusually high production. The USSR's production was about 38.5 million tons, an increase of 9% or three million tons.

U.S. Mining Firms Join Australian Co. in Iron Ore Exploration

Two U. S. mining firms, Cyprus Mines Corp. and Utah Construction & Mining Co. have formed a joint venture with Consolidated Gold Fields (Australia) Pty., Ltd. to explore for iron ore in Western Australia. The three firms have been granted permission by the Western Australian government to prospect over 308,256 acres in the Ellarine Hills area where there are possibilities of substantial deposits of iron ore. The Ellarine Hills area is just east of Port Hedland, Western Australia.

House Subcommittee Getting Industry's Views on Metals Imports

The House Labor Subcommittee has begun hearings of the metals industry in regard to the effects of imports on national employment. During the first day of the hearing, several steel industry and labor spokesmen stated that imports need not be curbed. Subcommittee Chairman John H. Dent hopes to get steel and aluminum producers' overall views concerning tariff increases on imports (although he states he is not necessarily advocating such an increase). Additional hearings are scheduled for the copper and brass industries and possibly for the lead-zinc industry to learn their opinions on increasing tariffs as they affect job protection.

Iron Ore Inventory Shows Rise Over 1960

Stockpiles of U. S. iron ore at furnace yards are much larger than they were one year ago. Total inventory at the end of June recorded 59,133,979 gross tons, 7.3 million tons more than last year. June consumption of iron ore was 8,544,967 tons while receipts were 11,301,667 tons.

between AMSCO and other hard rock track shoes

There's *more than just a little difference* between Amsco manganese steel hard rock track shoes and other brands. Amsco shoes are built to take the impact and abrasion of the hardest rock.

H. E. Lowdermilk Construction Company, Englewood, Colorado, and Espanola, New Mexico, specializes in rock work where the going is rough and tough. Standard track shoes for one of their HD21's *wore out completely* in as little as 270 hours. Amsco 26″ manganese steel track shoes were specified and 302 hours later wear was only $\frac{3}{16}$″.

Mr. Howard Neff, mechanical superintendent for Lowdermilk, can actually measure the difference between the Amsco shoes and the ones they used to use. You will too. Just ask for Amsco shoes, available for all major makes of crawler tractors and in any special design you need.

Amsco makes a complete line of cast tractor parts, including end bits, replaceable sprocket rims, grouser bars and welding electrodes for buildup, repair and hardfacing.

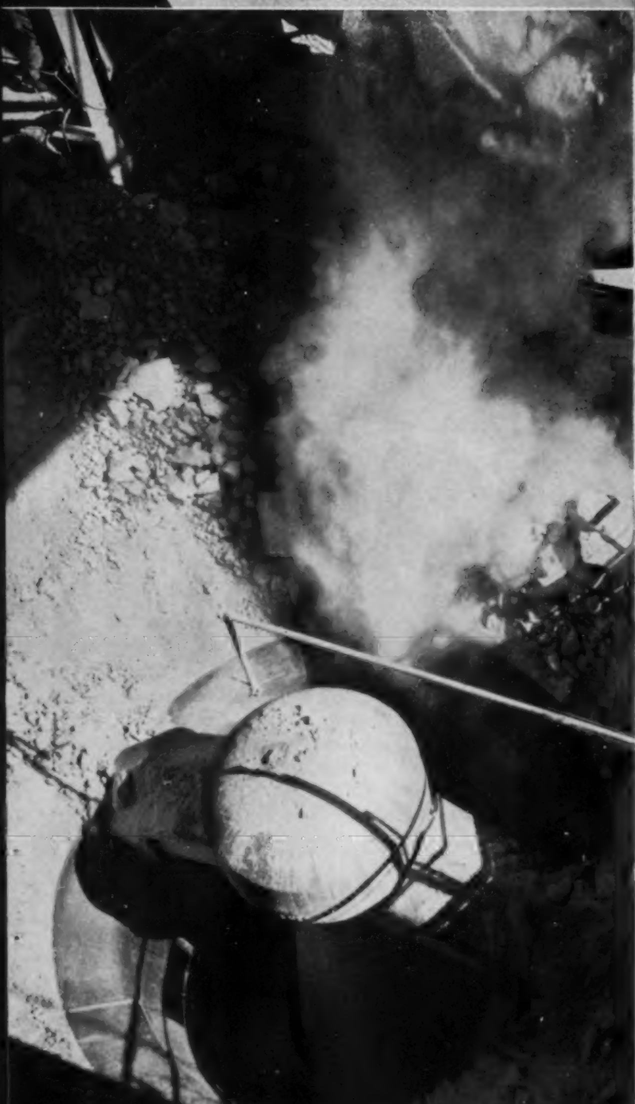
AMSCO

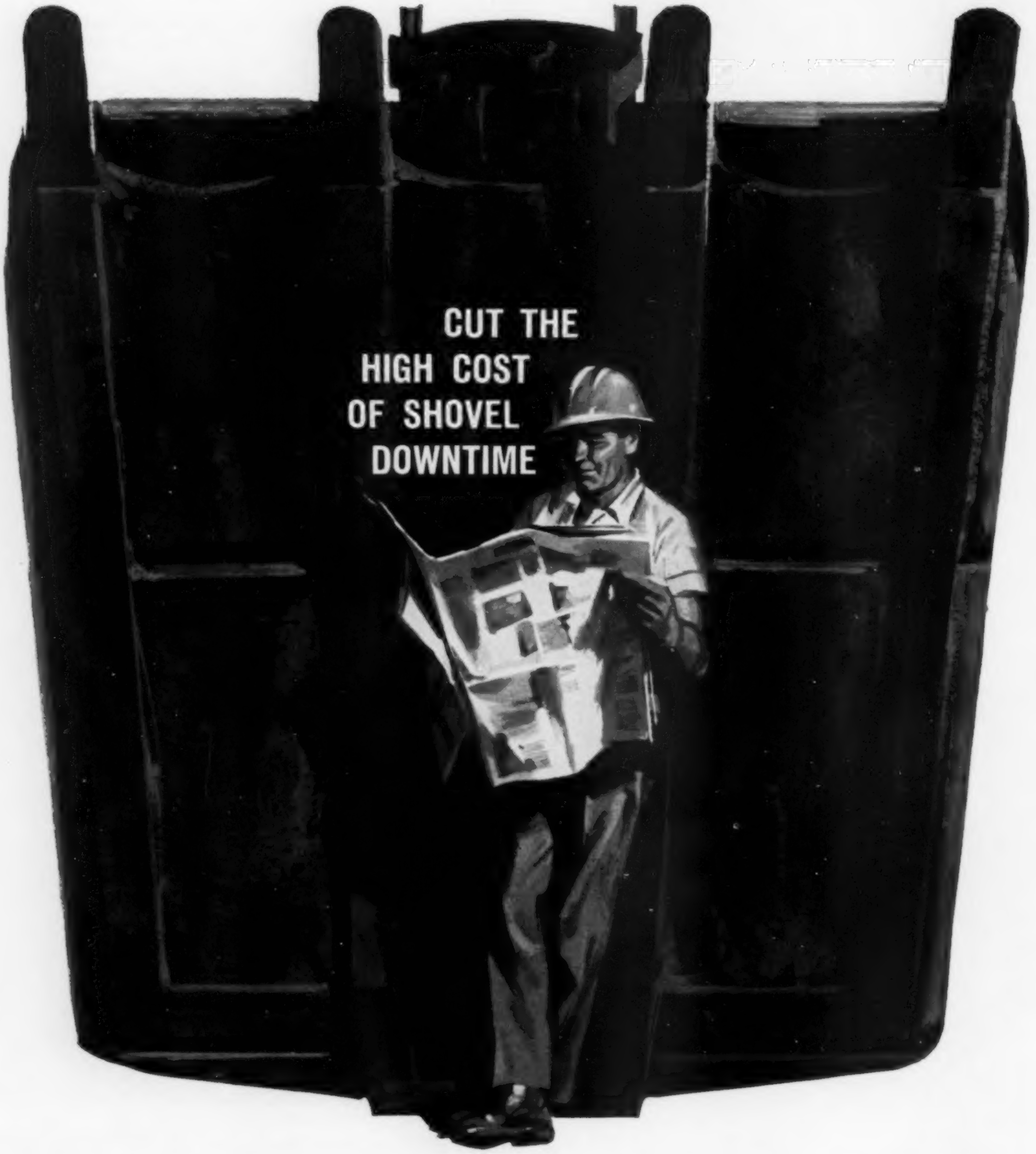
AMERICAN MANGANESE STEEL DIVISION
CHICAGO HEIGHTS, ILLINOIS

AMERICAN Brake Shoe COMPANY

Other plants in:
Denver • Los Angeles • New Castle, Delaware
Oakland, California • St. Louis
IN CANADA: Joliette Steel and Manitoba Steel Foundry Divisions
IN MEXICO: Amsco Mexicana, S.A.

Circle No. 19 on the reader service card.





Specify Anaconda all Butyl Shovel Cable

This new shovel cable—the toughest in the industry—cuts shovel downtime. Months of torture testing throughout the country have proved it.

It endured the rugged cold of the Mesabi and the punishing heat of Florida's phosphate mines.

It was twisted, kinked, soaked, crushed and run over.

Its new Butyl *jacket* is the reason for this extra durability in the face of the effects of ozone and moisture and extreme physical punishment.

It is especially compounded to combine flexibility at low temperatures with thermal stability at high temperatures.

Here are other construction features which contribute to this cable's unequalled service record:

1. Anaconda's rubber-core grounding conductors offer a cushioning effect which minimizes pinching and wire breaking and offers greater ground contact protection.
2. Special shielding—a combination of copper cross-braided with cotton—eliminates chafing (and makes splicing faster and easier too).
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AIME TRANSACTIONS (MINING)

Volume 220, 1961

As Transactions papers are accepted for the forthcoming volume, the titles and abstracts will be published in MINING ENGINEERING. The continuing list appears below. Watch for additional announcements which will be listed on the "Contents" and "SME Bulletin Board" pages in future issues.

Anticipated Publication Date: December 1961

TN 61B200 (Minerals Beneficiation) *Contact Angle on Galena as a Function of Oxygen Concentration* by R. R. Beebe and C. E. Westly.

60AU221 (Underground Mining) *Roof Slope at Deflected Supports* by Lawrence Adler.

Analysis of a mine roof can be based on fixed-end beam behavior. The author here analyzes the effects of zero restraint at deflecting beam supports. Formulae are given for determining permissible support deflections.

59F85 (Coal) *Coal Characteristics and Their Relationship to Combustion Techniques* by T. S. Spicer.

The relationship of coal characteristics to the principal types of firing equipment has been well known to the coal combustion engineer, but not familiar to purchasing agents, salesmen, consumers, and executives of coal-producing and consuming companies. This general survey is directed toward the latter audience. The characteristics of coals as determined by standard laboratory tests are discussed; the major types of combustion techniques reviewed; and characteristics and firing related.

61B20 (Minerals Beneficiation) *Flotation of North Carolina Spodumene-Beryl Ores* by James S. Browning.

For Abstract, see page 666, MINING ENGINEERING, July 1961.

61B227 (Minerals Beneficiation) *Density Chart for the Preparation of Heavy Liquids for Mineralogical Analysis* by Charles B. Sclar and Alfred Weissberg.

A graphical solution is presented for the equation

$$v_b = v_a \frac{(d_a - d_m)}{(d_m - d_b)},$$

where v_b is the volume of liquid "*b*" of density d_b that must be added to liquid "*a*" of volume v_a and density d_a in order to obtain a heavy-liquid solution of preferred density d_m for mineral fractionation. The equation is valid only for pairs of liquids whose volumes are additive, but empirical density-composition data show that this condition is met over wide compositional ranges by all of the heavy solutions that are commonly used for mineralogical analysis.

The chart is a nomograph which consists of two horizontal volume scales and a vertical density scale arranged so that one volume scale occurs on each side of the density scale. All the scales are linear. For two liquids of density d_a and d_b, respectively, each volume scale has an independent level on the density scale, and the graphical solution for v_b on the nomograph is obtained by construction of one straight line. The chart can be prepared easily to cover any density range with any desired accuracy by proper scale selection.

60B219 (Minerals Beneficiation) *Size Distributions and Energy Consumption in Wet and Dry Grinding* by D. W. Fuerstenau and D. A. Sullivan, Jr.

In the experimental work for this comparison of wet and dry grinding, it was found that the size distributions for wet grinding operations are characterized by a constant value of the distribution modulus, α; whereas, for dry grinding the distribution modulus decreases slightly with increased size reduction. Wet grindability seems independent of the weight of material in the mill while dry grindability depends on weight. Experimental data and equations for each process are presented for noncleavable isotropic material, for cleavable or material in which there is some form of internal stress, and for energy consumption. The equation

$$E_D/E_W = B\,k^{-\gamma}$$

(where E_D and E_W are, respectively, energy for wet and dry grinding, k is the size modulus, and B and γ are constants) was found to give the ratio of energy.

61B12 (Minerals Beneficiation) *Beneficiation of Cement Raw Materials by Dwight-Lloyd Processes* by Charles D. Thompson, Charles A. Czako, and Donald C. Violetta.

The mechanics of the continuous sintering process are briefly reviewed and the application of this process for the beneficiation of principal minerals used in making cement is shown. Pilot plant tests using pyrobeneficiation techniques were conducted with mixures of limesone and shale in various ratios. Results are illustrated and show the percentage removal of carbon, carbonates, sulfur, alkalies and volatiles as a function of the limestone-shale ratio. Tests with varying qualities of solid fuels, added to mixtures containing limestone and shale in a 4 to 1 ratio, were made to attain optimum elimination of the volatile constituents. Experimental results show that 90 pct of these constituents were removed during the calcination sintering process. The advantages of using the beneficiated material for making cement are discussed with regard to preparing, handling, and clinkering operations.

A sintering process for treating raw materials or kiln waste products which contain high amounts of alkaline materials is described. Tests were performed with a high alkaline waste dust mixed in a 1 to 1 ratio with raw cement meal. The data from these tests and others using different halides for aiding alkali removal are evaluated by the alkali content of the cement clinker. Test results showed that the Dwight-Lloyd process could be applied with facility in beneficiating raw materials for cement making. Substantial quantities of deleterious volatile constituents were removed by calcining and sintering techniques.

60F23 (Coal) *Face Ventilation in Development with Continuous Miners* by William Poundstone.

The mining and ventilating system used in development work in the Pittsburgh Seam in northern West Virginia continues to be investigated at the Humphrey Mine, Christopher Coal Co. Seam conditions and nature of the accompanying methane gas are described. Type of equipment and the mining cycle are discussed and it is shown how they are well suited for very gaseous development work.

Abstracts of the following papers appeared in previous issues:

MINING

59AU210 *Blasting Theories and Seismic Waves. Part I: Resume of Recent Blasting Theories* by A. W. Ruff.
59AU109 *Blasing Theories and Seismic Waves. Part II: Seismic Wave from Plaster and Drill-Hole Explosive Charges* by A. W. Ruff.
TN 60A214 *Lined-Cavity Shaped Charge and Its Use as a Drilling Tool* by C. F. Austin.
60A0155 *Portable Crusher for Open Pit and Quarry Operations* by B. J. Kochanowsky.
TN 60A0115 *New Method for Determining the Tensile Strength of Rocks* by N. E. Grosvenor.

COAL

60F106 *Experimental Work in the Degasification of the Pittsburgh Coal Seam by Horizontal and Vertical Drilling* by G R. Spindler and W. N. Poundstone.
60F65 *Daily Maintenance and Complete Overhaul of Continuous Miners* by J. Mason.
59F117 *Investigation of Materials and Methods of Construction Used for Stoppings in Coal Mine Ventilation Systems* by C. T. Holland and W. J. Skewes.
60F40 *Tube-Furnace Method for Rapid Determination of Sulfur in Coal* by G. D. Coe and G. E. Keller.

GEOLOGY

61I222 *Magnetic Taconites of the Eastern Mesabi District, Minnesota* by J. N. Gundersen and G. M. Schwartz.

GEOPHYSICS

60L83 *Model Studies of an Apparatus for Electromagnetic Prospecting* by H. E. Swanson.
61L6 *Relationship of Graphite in Soils to Graphite Zones* by W. H. Dennen and H. Linder.

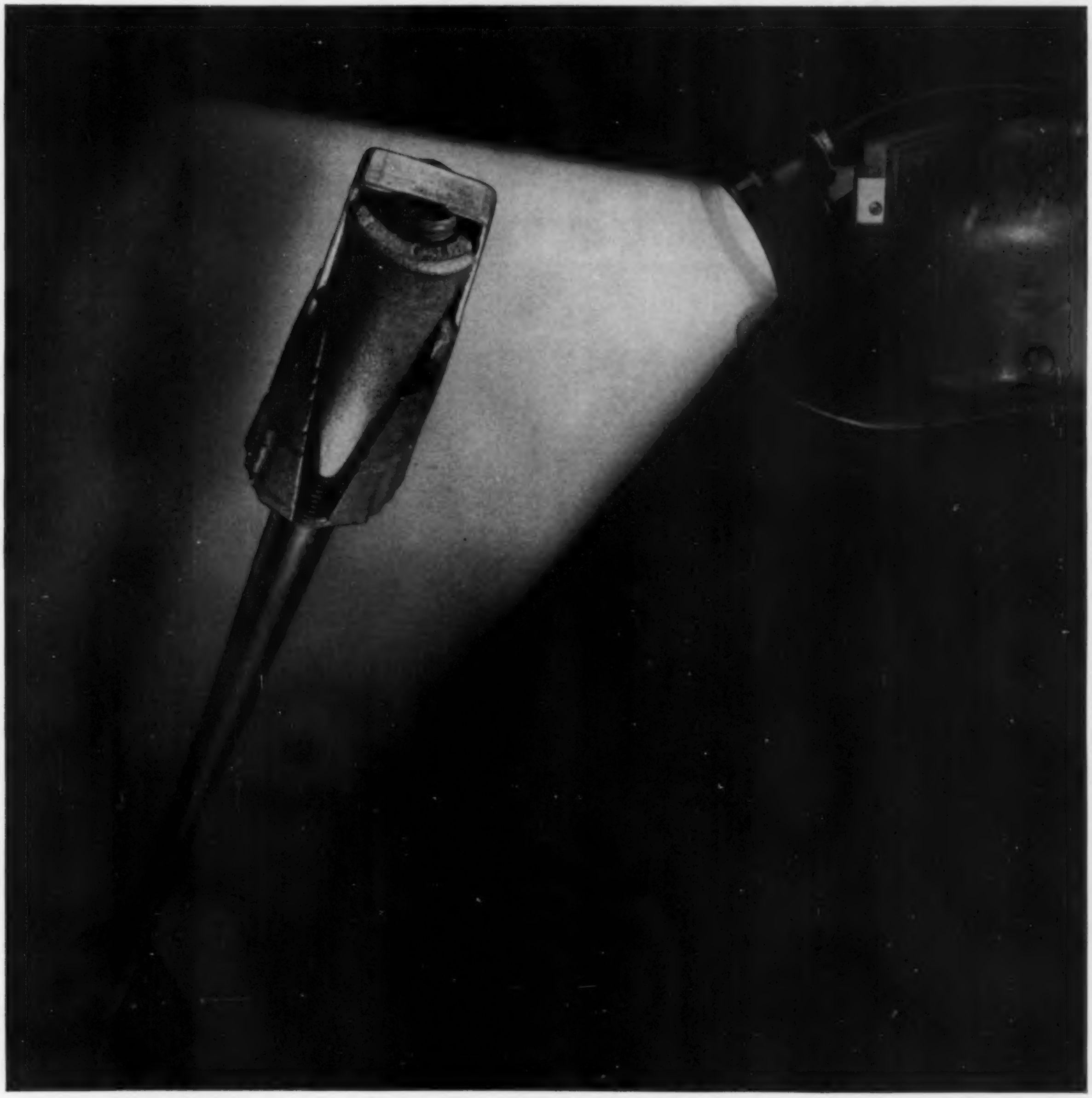
INDUSTRIAL MINERALS

60H48 *Some Beneficial Techniques Applicable to Mineral Fillers* by D. R. Irving.
61H41 *Chemical and Metallurgical Limestone in Northern and Northeastern States and Ontario* by K. K. Landes.
60H46 *Developments and Research in the Sawing of Slate* by F. D. Hoyt and H. L. Hartman.

MINERALS BENEFICIATION

60B232 *Fatty Acids as Flotation Collectors for Calcite* by M. H. Buckenham and J. M. W. Mackenzie.
TN 60B225 *Heavy Media Grinding* by H. J. Oberson and J. H. Brown.
TN 60B213 *Flotation of Cummingtonite* by I. Iwasaki, S. R. B. Cooke, and H. S. Choi.
60B103 *Fracture and Comminution of Brittle Solids* by J. J. Gilvarry and B. H. Bergstrom.
TN 60B228 *Size Distribution Resulting from the Comminution of Heterogeneous Materials* by D. W. Fuerstenau.
60B72 *Recovery of Molybdenum by Liquid-Liquid Extraction from Uranium Mill Circuits* by C. J. Lewis and J. E. House.
60B5 *Size Distribution Shift in Grinding* by G. Agar and R. J. Charles.
59B78 *Flocculation—Key to More Economical Solid-Liquid Separation* by R. H. Oliver.
60B102 *Energy Aspects of Single Particle Crushing* by B. H. Bergstrom, C. L. Sollenberger, and W. Mitchell, Jr.
59B239 *Proposal for a Solomonic Settlement Between the Theories of Rittinger, Kick, and Bond* by R. T. Hukki.

NOTE: Copies of papers will NOT be available until after publication.



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50 Years Ago . . . A Grape and a Glass of Champagne

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"An apocryphal tale . . . has it that the invention came at a banquet. Bored with the speeches and surfeited with champagne, one of the patentees dropped a grape he had been fingering into his recently replenished glass. Shortly his attention was caught by the repeated movements of the grape . . . slowly upward, stationary for a second at the surface and then downward more rapidly.

Immediate cause was quickly localized as the champagne bubbles adhering to the grape where it had been fingered and causing it to rise; loss of bubbles at the surface as they merged with the atmosphere, followed by sinking of the grape.

By casting in a grape that had not been so handled, the minds of the inventors identified the fingering as the reason for the bubble adherence. Application of the phenomenon to the tailings piles at Broken Hill flashed full grown as a possibility".

Arthur F. Taggart in *"Seventy-five Years of Progress in the Mineral Industry"*

Once the underlying principle of chemical flotation was perceived, progress in its application was measured only by the development of suitable reagents. Bulk flotation of values from gangue expanded rapidly as rudimentary yet effective reagents quickly became available. But precise selective flotation waited upon countless hours of basic research and creative chemistry.

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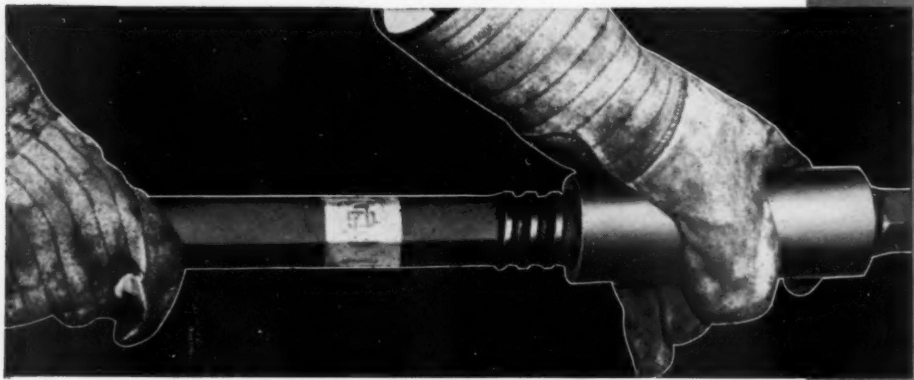

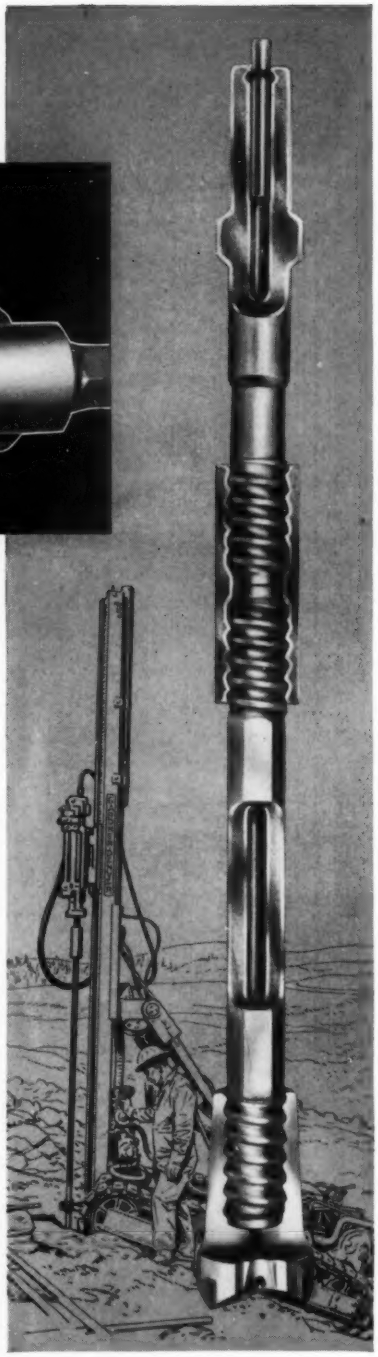

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Sends more impact to the bit—because rod and coupling threads are in close contact over a large total area; rod ends are held firmly together.

Drills more footage per rod—because steel is carburized and shot-peened; wide-thread peak assures maximum wear.

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THE DRIFT OF THINGS

as followed by J. V. Beall

A special project is scheduled for this office over the Labor Day weekend. It hasn't been given any name or code appropriate for enterprises of this magnitude. What it is, is that the movers are coming. They say we can go away on Friday before Labor Day and when we go to work on Tuesday it will be in the spanking new United Engineering Center on the United Nations Plaza.

Sitting here looking out the windows at the hat manufacturing industry for close to the last time it is difficult to believe that when we next write this column we'll have the splendid view of the United Nations plaza and panorama of the East River.

The engineering societies have occupied the present building since 1906. The building was constructed mostly on the donation of Andrew Carnegie who gave $1,050,000. The Founder Societies bought the land. The $12 million United Engineering Center has been financed by 83,878 individual and corporate subscriptions. AIME raised over half a million dollars through some 9000 individual subscriptions from more than a quarter of its total membership. This is a monumental achievement; indicative of the solidarity and devotion of engineers to their profession.

Most of us working here for the engineering societies have had little to do with the fund raising and development of the United Engineering Center. Most of this work has been done by volunteer members of the Founder Societies who have given unstintingly of their time and imagination. To be sure, the top executives of the Societies have been also deeply involved. In looking forward as we do to the advantages of the United Engineering Center with its modern, efficient, and comfortable accommodations we do not lose sight of the overall implication of the transition. The United Engineering Center is a tangible expression of engineers everywhere of loyalty to their profession, confidence in the future, and pride in their part in shaping the destiny of the Nation.

It must have been quite a blow to Anaconda to hear Enrique Serrano, Mining Minister of Chile, putting a plan to the legislature of forced expansion of copper mines. The El Salvador mine is hardly warmed up and represents a big chunk of the $253 million that company has spent expanding copper mines in Chile in the last ten years. It was midsummer here and midwinter in Santiago when the furor broke which had undertones of nationalization or expropriation of mines from responsible and influential Chileans. The entire problem from the Chilean standpoint is a package of need for better conditions for the population and fiscal stability.

Chile is a great country for copper, iron and nitrate mining. Its sound in lumber and agriculture. Its in a class by itself for trout fishing, skiing, and just natural beauty. The population is energetic and amiable being with good Iberian base and European and Middle Eastern additives. German influence is pronounced. The Indians can't be sneezed at either, their stock-in-trade being courage which is duly documented.

However there is a tendency down there toward aristocracy. "You don't pay people—you take care of them" type of thinking. Most of the money is in this group. There are also the

smart small businessmen who can see a need and move into it with a manufacturing plant or service organization. But there isn't enough distribution of money among this latter type.

The copper companies have living standards for their workers which are not equaled elsewhere in the country, not even closely. They are the target or goal for all Chilean labor (but they want it closer to town or the green part of the country).

After all the years of friendship and fruitful cooperation between Chile and the copper companies, its painful to see a government hang its progress on the vicissitudes of the copper market. When there is profit in expansion, the U.S. investor will back it; Chile cannot legislate a market for its copper.

The industrial and business possibilities to give the people of Chile what they deserve exist. We don't know what it takes to move capital into producing the equivalent of Scott's tissue or freezing for export the delectable *cóngrio* but this is the line our friends should follow. A good miner keeps stulled up till the timber set is in and the lagging overhead. Chile should follow his example and not knock out the big stull—copper, which it needs.

To those who have sons studying engineering and to our Student Associates comes a thoughtful word from the AIME Board of Directors regarding engineer licensing. Apparently the outlook for the future is toward expanded licensing of engineers, closer coordination between the State Boards of Engineering Examiners, and improved status for the engineer. As a preparatory step toward final licensing, students are urged to take engineer-in-training examinations upon graduation from college. The successful candidate wins "Engineer-in-Training" certification. Following some years of experience he may take a second examination, if he passes he becomes a licensed professional engineer.

Some states will offer examinations which permit the candidate to qualify in his chosen field of geological, mining, metallurgical, or petroleum engineering. Whether a specialized examination is offered or not it is best to take the examination on engineering fundamentals shortly after graduation when a minimum of boning up will be needed. It is also noted that there is a greater degree of reciprocity between states in licensing matters where the candidate has been qualified by examination rather than under an "eminence" clause.

A good way of securing information is to talk to a member of your State Registration Board. The Secretary of the National Councils of State Boards of Engineering Examiners, P. O. Drawer 752, Clemson, S. C., can supply the address of the member state boards.

We must pass along the latest Melvinism received in a letter to Jack Fox from John H., whom you know is General Manager of the Pennsylvania Drilling Co. "I think you fellows are doing a great job with MINING ENGINEERING, particularly with the covers. The two tone job on Jim Gray in March was fine but your own profile on the April issue (cover) is out of this world. Congratulations. P.S. Who is the steno in the red dress standing between you and the camera?"

In browsing through that excellent daily newspaper, *American Metal Market*, we came across the latest in interesting switches under the caption "Soviet Industrial Labs Outbid by Universities." AMM's article is taken from USSR's *Ekonomicheskaya Gazeta* which declares that industrial research laboratories in the Soviet have a difficult time hiring scientists and technologists because they are outbid by the universities for this class of personnel. In fact the Universities pay three or four times more than research organizations can afford. The Russian paper bemoans this situation and offers a plea for better cooperation between the competing parties.

There seems to be a considerable amount of translating going on of Russian literature these days which is all to the good. Among other items of interest is one describing a new automated assembly line for chisel-type drill bits. It is a new installation at the Krasnolutsk Machine Construction Works which has increased production twelve times by replacing hand-operated vertical milling machines and welders with automated machining and heat treating line. The plant is a major producer of mining tools.

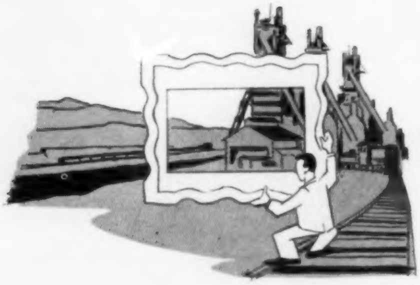
Paul T. Allsman and James E. Hill in their last "Review of Mining Technology" for the U.S. Bureau of Mines report the delivery by a Swedish company of the world's largest mining hoist. The 49-ton hoist drum will lift 50 tons skip loads at 33 fps from a depth of 3000 ft.

Pacific Gas and Electric Co.'s Geysers Plant which operates unattended on geothermal steam is America's first economic unit. The plant generates 12,500 kw at 60,000 volts which is fed into the PG&E system.

The steam is tapped by four wells which are drilled down to depths ranging between 500 and 700 feet and deliver 240,000 lbs of steam per hour at 100 psi. Because of entrained rock particles and the corrosive quality of the slightly superheated steam, special precautions are necessary. Centrifugal cleaners are used to remove the rock particles and stainless steel is used in the turbine and other pipe and machinery with which the steam comes in contact. Power plant components are not complicated. The steam travels through a 20-in. pipeline about one quarter of a mile to drive the turbogenerator. Steam is condensed in a barometric condenser. A tower is used to cool the circulating water for the condenser.

The Geysers have been known for over a hundred years and the hot springs, fumaroles, and steam vents brought tourists to the area. The near surface magma creates steam from inherent water and in addition surface water is vaporized by the hot rocks. There has been no visible diminution in estimated vapor production since the phenomenon has been under study.

IRON ORE: THE BIG PICTURE



by

E. H. ROSE

It must be evident to almost everyone by now that a massive transformation is occurring in our iron ore economy. Its equal has been seen only once before in the entire history of the North American steel industry, and not even once before within the personal memory of anyone now engaged in it. The lone precedent was the beginning of ore shipments from the Mesabi Range in October, 1892, which was before anyone still short of normal retirement age had been born. No younger observer, in the steel industry or in any other, has ever known anything else than that the Lake Superior region—in which the Mesabi is the giant—has supplied all but a small fraction of total North American blast furnace ore for the use of three generations of steelmakers.

Directly or indirectly, it was the discovery of the Mesabi which created most of the prime and satellite companies that have since come to prominence in the various ore-consuming phases, and it was the same discovery that had broader effects on the entire spectrum of their technologies than any other single event that has ever happened since, although the advent of byproduct coke is a close runnerup. It affected every sector of the national economy and was a keystone in making our standard of living what it is today.

Now, almost as suddenly, the same thing is happening all over again for the first time in three generations—not all in one place but certainly on an equally magnificent scale. As before, the ores now coming into use were scarcely known to exist 15 years earlier, but like them, these new ores are indisputably able to meet U.S. requirements for many years to come. Apart from sheer size, they are capable of yielding an average shipping product approximately one-fifth higher in iron tenor than the historic standard.

Tables I, II and III show sources, tonnages and grades. Anyone may split hairs over the 1970 figures, but not those of 1960 which are the recorded actuality, nor of 1965 for which the enormous capital investments required have already been committed.

E. H. ROSE, Member of SME, is Chief Beneficiation Engineer, Koppers Company, Inc., Pittsburgh, Pa.

It is the spectacular improvement in chemical quality which necessarily denotes the impact upon all areas of use technology, given the basic circumstance that the ore reserves required to sustain this grade have already been proved.

Thus quality combines with quantity to underscore the statement that no one now active in the steel industry has witnessed a transformation of this magnitude within his professional lifetime. This is particularly apparent when looking over the record of grade in past years. In no single year from 1910 to 1958, according to the American Iron Ore Association, did the average grade of all iron ore used in North American blast furnaces exceed 52% Fe natural, with the merest whisker of an exception in the two depression years of 1921 and 1932. Such is the about-face that in the near future anything under 60% Fe will face competition previously unkown. The tables make it clear that a grade of over 60% Fe can be maintained for years to come, even at the highest annual consumption rate yet experienced in North America, and with Golden Rule deference to the exploding needs and wants of the rest of the world.

The swiftness of the change can be inferred from the fact that the earliest of the new properties did not come into commercial production until 1954. Seen in perspective, the ore discoveries, though widely dispersed, may be regarded as a single drama, like the acts and scenes in a Shakespearean play. The technical press has chronicled the individual events: the discovery of Cerro Bolivar in Venezuela on April 4, 1947 (the only major ore discovery since the California gold rush to be dated to the day) but from which commercial shipments did not reach the United States until 1954; the Labrador Trough, with direct shipping ore also first moving in 1954 without early appreciation of its fabulous reserves of beneficiation grade from which 20 million annual tons of 65% Fe concentrate are scheduled by 1965; exploitation of the Minnesota magnetic taconites with multi-million ton production beginning in 1956; Ontario, only now beginning to add surprising muscle of its own; Peru,

Brazil, and Chile adding multicolored pins to the hemispheric map; even Wyoming, Missouri, and Nevada beginning to light up where iron ore was not supposed to be; and finally Liberia, Sierra Leone, Mauretania, India, and other parts of the overseas world making iron ore headlines in bolder type each year.

Such were the events of ore discovery in the sense of finding it. Neither its discovery nor its economic utilization would have been possible but for the outright revolution which was occurring simultaneously in the technologies of logistics and materials handling, not to mention the earth sciences and especially the airborne magnetometer. There has been drama in the way that science, technology, and raw fortitude have tempered the Canadian and Siberian sub-Arctic in the habitational if not in the Fahrenheit sense; in the seaways where outsized gulps of global ore move by ships; and in the skills of beneficiation people everywhere changing the concept of what is *ore*, what ought to be *ore*, and what *ore* ought to be. Even the taxation oracles have begun to recognize the facts of life are not what they used to be, except in the sense that ore never did grow on trees—the Christmas kind or otherwise—and never will.

In terms of geographic source and overall chemical grade of ore, the period now receding might be called the Era of Constancy, although the silica content was slowly edging upward. Not only did the hemispheric economy grow solidly upon it, but so did the habit of looking upon iron ore as one of the eternal verities. "What," three generations have shrugged, "could be more routine than iron ore? It always comes down lakes and all I have to do is look in the tables to see what I am going to get next year—or ten years from now, for that matter."

The iron ore events of this decade are a matter of swiftly moving record, some of them undeniably heroic. In general, they are well enough known to the blast furance operator, but from his comfortable seat in the stands he has been prone to look upon them as a spectator sport. Indeed, Owen R. Rice, who is to blast furnaces about what Ed Davis is to taconite, has recently pointed this out, somewhat ruefully. Suddenly, the agglomeration engineer and the blast furnace operator find themselves as the starting pitcher and catcher in the second game of an unexpected double-header. It all may be a spectator sport, but no longer so for them.

The statistical scoreboard of the first game is set up as Tables I and II. Each is divided into three categories: (a) capacity actually installed since 1953 and now in production; (b) under construction or definitely planned to be in production by 1965; (c) trade press predictions by 1970.

This scoreboard is presented as the take-off point to reconnoiter what the new ore supply situation means to the several technologies of ore use. In terms of everything made of steel or in any way depending upon the quantity or quality of iron ore available, the Era of Constancy is within a single decade notching up to a higher plateau.

Over a billion dollars has been invested in the various taconite-type projects (not in Minnesota alone) which are now producing 20 million tons per year of 65% Fe pellets. Counting the exploration and development money, another billion has actually been committed in Quebec-Labrador for the production of another 20 million tons of concentrate of even better grade in three separate projects all scheduled for production by 1965 or earlier. Capital commitments already made or signified will bring in another 20 million annual tons of equally high-grade direct shipping ore from overseas.

Including other miscellaneous sources, all this adds up to the 86,650,000 annual tons shown for 1965, all of it plus 60% Fe and record low silica. In gross tons, without allowance for better grade, this is the equivalent of almost exactly two-thirds of all iron ore used for all purposes in the U.S. and Canada in the peak years of 1953 or 1957.

It would have been redundant to include data on ore reserves in Tables I and II, though the figures are available. In the mining business, capital investment actually made or committed is the sharpest possible criterion of ore reserves.

THE AGGLOMERATION OUTLOOK

Sintering was not even invented until 1906, and not applied to iron ore until 1908. Today the total North American ferrous sinter capacity is 65 to 70 million net tons annually. In round numbers, the capital cost of a modern sinter plant is $10 per annual ton.

The bulk of Lake Superior iron ore has always been direct-shipping. First record of commercial washing or beneficiation, exclusive of mere crushing or screening, dates from 1907 which coincides with the beginning of sintering.

By 1957, the total of all shipments of upgraded iron ore in the U.S. and Canada (washed, jigged, heavy media, magnetic, flotation, agglomerates, etc.) had reached 47 million gross tons, a phenomenal increase but still less than half the total U.S. and Canadian shipments of 118 million tons in that year.

Until perhaps 1940, when the pressures of World War II began to hurt, all agglomeration was looked upon as a necessary evil, which is to say, an expedient to permit use of minus ¼-in. fines which otherwise took wing in the blast furnace, especially on inexorably increasing wind rates. Practically all agglomeration of fines was by the sintering process. About this time, the real virtues of sinter were finally recognized.

The hounds of progress were soon off in full cry. Within the decade, the All-Sinter School was born of the doctrine that even coarse ore should be crushed and sintered "whether it needs it or not" for the sake of better and more uniform physical structure, with a bonus for expelling volatiles. By 1953, full-dress blast furnace tests had been run which proved the new school to be thumpingly right in its prospectus. Hot metal production per furnace-day climbed steeply while coke rates dropped. New sintering plants sprang up, some of them at the very furnace plants where old line operators had been adamant in their belief that a blast furnace could "never" operate at higher than 25% sinter burden.

An historic turning point was reached in 1956

when the first taconite came to market in the form of pellets made by a radically new process. By 1958, it had become clear that such pellets had many virtues in the blast furnace, some of them new and unheralded. Hardly anyone paused to ponder that the pelletizing process was launched on a concentrate made from an ore requiring a 200-mesh grind for liberation and in which the iron mineral was almost entirely magnetite.

By the end of 1959, annual pellet production from these new and history-making iron ore concentrators had reached 18 million tons, all of it (with one exception) from fine magnetite. These pellets performed so well in the blast furnace that the conclusion-jumpers quickly reached a soul-satisfying judgment: even if the mining people finally should reach the bottom of the direct-shipping barrel and everything thereafter had to be concentrate from fine-ground beneficiation grade iron ore, there would never be a crisis in the agglomeration business that pelletizing could not take in stride. Hardly had the words been said when a surprise shook the agglomeration business to its very foundations.

It occurred in 1958 when the Labrador Trough showed its true colors. At the Duluth Symposium of that year, A. E. Moss, then chief geologist of the Iron Ore Company of Canada, ad-libbed an aside to his paper: "If we had known four years ago what we know now, we would have started off on a beneficiation basis in the first place." True to his confession, Labrador concentrate production will reach 20 million tons annually by 1965 and Table II duly notarizes his testimony in hindsight.

It was no responsibility of his that the Labrador ore was so much more granular than Minnesota taconite that most of it liberated cleanly at 20 mesh instead of 200 or that the iron mineral was hematite instead of magnetite. Off-hand these two differences might seem minor, but their combined effect on pelletizing was devastating. The heirs of Davis, the father of pelletizing, found themselves in roughly the same quandary as Messrs. Dwight and Lloyd might have experienced when they started baking "sinter cake" in 1906, if somebody had sneaked up and put rocks in their dough and turned the heat off the oven at the same time. A flash-back to the early development of the pelletizing process will make this clear:

Despite the scorn of the faithless and/or well-fed, Davis and his associates began in 1915 to seek means of utilizing low-grade taconite, against the inevitable day they rightly foresaw when Mesabi's cupboard would indeed be bare. Being in their right minds, they began on the eastern end of the Range where the iron mineral is in the form of magnetite and hence much easier to beneficiate because of its ready response to direct magnetic separation.

When their researches resulted in minus 200-mesh concentrate (because that is the way the Lord made the ore they were working with), they realized that their beneficiation effort would be fruitless without one more step because material so impalpable could not be sintered in the conventional sense by any then-known means.

In this unique howdy-do, the invention of pelletizing was mothered by necessity. That their pellets should behave in a superior manner in the blast furnace was a dividend these pioneers may have anticipated but vindication was still years away.

In modern pelletizing, the finely divided concentrate is mixed with a critically optimum amount of free moisture (about 10%) and a percent or so of a plasticizer, usually bentonite clay. When this mixture is discharged by conveyor or mechanical feeder upon an inclined and moving surface, such as an open-end revolving drum, and tumbled at appropriate speed, the mixture nucleates into "seed pellets" which grow in a manner often likened to that of a snowball rolling downhill over moist snow. By choice of moisture content, slope and speed of surface, balls may be "grown" to selected sizes. The diameter of pellets now preferred by blast furnace operators is ⅜ to ½ in.

The screen oversize in the form of dough-balls must have enough "green strength" to be conveyed to the hardening process. Sufficient heat is applied to cause intergrain growth and/or recrystallization. This temperature may be a little below that of conventional sintering, but not much. The indurated pellets must have enough physical strength not only to withstand degradation during transpor-

Table I. Summary of 60-69% Fe Direct Shipping Ore Imported by U.S. from Overseas Sources*

	Thousands Long Tons Per Year						
	Actual		Expected		Possible	1965 Grade	
Source	1950	1955	1960	1965	1970	% Fe	% SiO_2
Algeria	500	20	—	—	—		
British West Africa	200	140	—	—	—		
Tunisia	120	—	—	—	—		
Liberia	0	900	1200	4000	6000	67.0	4.0
Sweden	2050	1200	200	200	200		
South America							
Brazil	700	1000	1700	7000	10,000	68.0	1.0
Chile	2000	2000	4000	6000	8000	62.0	5.0
Peru	—	1600	3000	4000	6000	60.5	7.0
Venezuela—Cerro Bolivar	—	7150	13,000	15,000	18,000	64.0	1.0
—El Pao	—	3500	3500	3500	3500	68.0	0.5
Total—South America	2700	15,250	25,200	35,500	45,500		
Grand Total	5570	17,510	26,600	39,700	51,700	65.0	2.9

* Includes open hearth lump.

Table II. Summary of New Sources of High Grade Concentrate (Plus 60% Fe), U.S. and Canada

Property	Location	Year of First Production	Thousands Long Tons Per Year	Dry Basis % Fe	Dry Basis % SiO_2
CAPACITY NOW INSTALLED					
Extaca (U. S. Steel Experimental)	Minn.	1953	600	62.0	
Reserve Mining Company	Minn.	1955	5000	62.5	
Cleveland-Cliffs Humboldt	Mich.	1955	300	63.5	
Cleveland-Cliffs Republic	Mich.	1955	600	63.5	
Marmarton (Bethlehem)	Ont.	1955	500	64.8	
International Nickel	Ont.	1957	150	68.0	
Erie Mining Company	Minn.	1958	8000	62.5	
Hilton (Stelco)	Que.	1958	300	67.0	
Bethlehem Cornwall pellets	Pa.	1958	1500	63.0	
Low Phos Iron Co. (Hanna)	Ont.	1959	550	62.0	
Groveland (Hanna)	Mich.	1959	700	60.0	
Total			18,200	63.0	8.2
UNDER CONSTRUCTION OR DEFINITELY PLANNED BY 1965					
Lac Jeannine (U. S. Steel)	Que.	1961	8000	66.0	
Republic Increase	Mich.	1961	600	63.5	
Meramac (Bethlehem)	Mo.	1962	2000	64.0	
Atlantic City (U. S. Steel)	Wyo.	1962	1000	65.0	
Humboldt Increase	Mich.	1962	300	63.5	
Carol Lake (Hanna)	Que.	1963	6000	66.0	
Wabush (Pickands Mather)	Que.	1963	6000	66.0	
International Nickel Increase	Ont.	1964	850	68.0	
Reserve Mining Increase	Minn.	1962	4000	62.5	
Total			28,750	65.3	5.0
TRADE PRESS PREDICTIONS BY 1970 (Finance and Market Permitting; Sufficient Reserves Already Proved; Concentrating Tests Completed)					
Taconite and Jasper Concentrate in Addition to Above*	U. S. Upper Great Lakes	Prior to 1970	13,300	62.0	
Anaconda	Ont.	1965	2000	65.0	
Normanville (J. & L., Cleveland-Cliffs)	Que.	1965	2000	65.0	
Noranda	Que.	1965	100	68.0	
Minerals Engineering	Mont.	1965	200	65.0	
Agenda (Detroit Steel)	Wis.	1965	500	65.0	
Labrador M. & E. (Timmins)	Que.	1965	4000	68.0	
Rio Tinto	Ont.	1966	1000	66.0	
Can-Fer	Ont.	1966	1000	65.0	
Jalore (J. & L.)	Ont.	1968	1000	65.0	
Albanel (Cleveland-Cliffs)	Que.	1968	3000	66.0	
Southern Pacific Railway	Nev.	1968	1000	66.0	
St. Joseph (Steep Rock)	Ont.	1970	3000	65.0	
Ungava Iron (Cyrus Eaton)	Labr.	1970	5000	65.0	
Great Whale (Little Long Lac)	Labr.	1970	2000	66.8	
Woodward Iron Company	N. J.	1970	1000	68.0	
Total			40,100	64.5	6.0

* From U. S. Tariff Commission Report, March, 1959; specific locations not stated.

RECAPITULATION

Now Installed	18,200	63.0	8.2
Under Construction or Definitely Planned	28,750	67.0	4.0
Possible Between 1965-1970	40,100	64.5	6.0
Total	87,050	64.5	5.8

NOTE: The above does not include old-established and conventional sources of high grade concentrate such as the Adirondacks, Pennsylvania, New Jersey, and Tennessee Copper, now totalling about 3 million annual tons at 64% Fe.

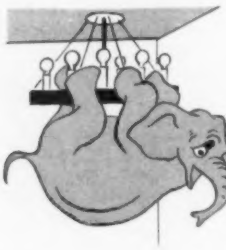
Table III. Expected Analysis High Grade Concentrates and Ores (Dry Basis)

Property	% Fe	% SiO_2	% Al_2O_3	Rice Ratio*	% CaO	% MgO	% Mn	% S	% P
Concentrate (in Production)									
Reserve Mining	62.48	9.0	0.54	6.55	0.50	0.65	0.22	?	?
Cleve. Cliffs	63.66	8.98					0.05	0.005	0.035
Erie	62.8	7.0	0.5	8.3					
Marmarton	64.85	4.0	0.5	13.0					
Hilton	67.08	1.84	0.36	30.4	0.44	0.53	0.08		0.005
Int. Nickel	68.0	1.5	0.65	32.0	0.25	0.30	0.05	0.01	0.003
Bethlehem Grace	63.0	4.9	0.5	8.6			0.05	0.047	
Low Phos Iron	60.06	7.42	0.45	7.7	1.50	1.48	0.71	0.02	0.02
Tenn. Copper	68.0	1.5	0.3	37.6					
Concentrate (by 1965)									
Quebec Cartier	66.19	4.67	0.32	13.20	0.02	0.03	0.02	0.005	0.03
Carol Lake	66.0	4.75	0.30	13.10					
Wabush	66.50	4.00	0.30	15.50					
Meramac	64.0								
Atlantic City	65.0								
Concentrate (Possible by 1970)									
All	63-67								
Overseas Direct Shipping Ores (Present or Future)									
Cerro Bolivar	63.75	0.74	1.06	35.4	0.29	0.26	0.02	0.03	0.088
Bethlehem, Venezuela	68.0	0.30	1.90	30.8			0.05	0.03	0.03
Marcona, Peru	60.5	7.0	1.5	7.1	1.2	1.0		0.17	0.055
Liberia	63.0	3.0	0.7	17.0				0.04	0.07
Brazil	68.5	0.43	0.51	72.8			0.07		0.036

* Rice Ratio is: $\frac{Fe}{SiO_2 \text{ plus } Al_2O_3}$

tation to the blast furnace but to retain that strength right down to the instant of reaching the actual smelting zone.

The heat-treating phase of the operation may be carried out in any one of a dozen different types of units, such as travelling grates, shaft furnaces, many kinds of kilns, and their various combinations.



Until the Quebec-Labrador concentrate came along, the only problem was choosing the most economic pelletizing process. But here, instead of being practically all minus 200 mesh like present feed to existing pelletizing plants, Labrador concentrate is nearly all on the coarse side of that magic line—and there are hundreds of millions of tons of such stuff ahead to deal with. Apart from being hematite instead of magnetite, all of the turmoil has been created by that single stumbling block of size structure. Following are the predicted screen analyses for the concentrate from the three new Wabush Lake concentrators shown in Table II:

Expected Screen Analyses of Concentrate

	Lac Jeannine (U.S. Steel)		Carol Lake (IOCO)		Wabush (Pickands Mather)	
Tyler Mesh	This Mesh	Cumulative	This Mesh	Cumulative	This Mesh	Cumulative
20	19.8%	19.8%	0.3%	0.3%	0.98%	0.98%
28	—	—	2.3	2.6	4.15	5.13
35	39.9	59.7	6.4	9.0	8.98	14.11
48	—	—	10.9	19.9	17.74	31.85
65	26.8	86.5	21.2	41.1	20.07	51.92
100	6.7	93.2	20.8	61.9	21.23	73.15
150			17.2	79.1	13.55	86.70
200			11.9	91.0	8.67	95.37
−200			9.0	100.0	4.63	100.00

Such material is not only much coarser than anything in previous pelletizing experience but at the same time is too fine for sintering by conventional means, taken by itself, without prohibitive sacrifice in production per square foot of grate area per day, due to reduced bed permeability as a function of grain size. Some may be on the sinter border-line.

The nub of the problem lies on the "green strength" of the pre-fired pellets, which, of course, includes persuading them to roll into pellets in the first place. The layman, not familiar with the intrinsic meaning of screen analyses, might scan the above table and wonder what the excitement is about. After all (when he looks it up), a 28-mesh particle has a diameter of 0.0232 in., compared with 0.0029 in. for a 200-mesh particle. A two-hundredths of an inch difference is only for precisionists. Why should an agglomeration engineer suddenly be so finicky when he has to process tens of thousands of tons of concentrate per day and at the same time make cost? In sintering, he has been happy for 50 years on "quarter by zero" feed.

Simple arithmetic should tell the layman otherwise. For grains of any given mineral, considered as perfect spheres and taking 200 mesh as unity, following is the comparison of surface and volume of particles within the size range that is causing the pelletizing trouble:

Ratios of Surface to Volume in Mineral Particles
(Taking 200 mesh as Unity Diameter)

Tyler Mesh	Diameter (D)	Surface (f/D^2)	Volume (f/D^3)
200	1	1	1
100	2	4	8
48	4	16	64
28	8	64	512

(Example: A 28-mesh particle has 512 times the volume or weight but only 64 times the surface of a 200-mesh particle of the same material.)

What this innocent-looking table leads to will be developed in a moment, but if our layman needs a visual aid to education, let him look at it this way: Taking a 28-mesh grain arbitrarily as an ordinary horse, then the 48-mesh grain is a sheep, the 100-mesh grain is a cat and the 200-mesh grain is a mouse. Trying to lock all of these in the same cage and keep them there is, to put it mildly, something of a problem, even forgetting that *minus* 200-mesh is down among the ants and the aphids. It poses real trouble for the pelletizer for the same reasons as indicated by this not-so-far fetched metaphor. In fact, the metaphor is an understatement, for the pelletizer must pack them in, hide-to-hide with no unbridged space between them in any direction, and on top of that the concentrator sets the number of specimens of each species that must be put in each cage, as indicated in the screen analyses above. The ratio of horses-to-sheep-to-cats-to-mice is fixed in number. The trouble this gets the pelletizer into may be seen by examining the forces tending to pull the green pellet apart all through the act of trying to stick it together.

The individual grain can attach itself to the forming glomerule only through that portion of its surface that comes into contact with it. Surface is a function of the square of the particle diameter. The particle is to the glomerule what an alpine climber is to a cliff: gravity and nothing but gravity is trying to pull him down against the strength of his own muscles. His weight is a cubical function but his strength is limited by the square diameter of his biceps. That is essentially the reason why (a) houseflies can walk on the ceiling but elephants cannot, and (b) minus 200-mesh concentrate pelletizes easily but 28-mesh does not.

The layman immediately sees an easy way out: to pelletize 28-mesh concentrate, just grind it to 200-mesh first. He would confer validity upon our horse-sheep-cat-mouse metaphor by proposing the sausage route.

The cubes-vs-squares discipline quickly dims that hope because Rittinger's Law says that the energy required for grinding any material is proportional to the new surface produced. Therefore the energy requirement is over ten times as much to reduce a ton of 20-mesh material to 200-mesh as had been required to reduce that same ton from eight inches to 20-mesh. Considered as perfect cubes, this is the way it works out:

	Surface Area, sq. in.
An 8-in. cube	384
The same cube reduced to 20-mesh	93,400
The same cube reduced to 200-mesh	1,059,300

What sense would it make to take pure Labrador concentrate and spend vast amounts of energy grinding it to flour in order to pelletize it and so make it a

little coarser than it was to begin with? On the above surface area relationship, this necessitates three times as much energy as was required to grind the total crude ore to the 20-mesh concentrating size, assuming that you grind three tons of crude ore, throw away two tons of tailing without regrinding, and regrind the remaining ton of concentrate to 200 mesh.

To grind to 200-mesh at any one of the Quebec-Labrador concentrating plants now under construction would require about 25,000 additional installed horsepower at each place, according to D. N. Vedensky, who verified his arithmetic by actual grinding tests. The capital cost of the required power plant and grinding plant would come to about $20 million. The operating cost, including interest on the investment and all other indirect costs, would be about 75¢ per ton, not forgetting that part for the tax collector.

There is no gainsaying that this procedure would accomplish the objective; in fact, there is one commercial plant elsewhere that is doing it now. Whether there might be better or cheaper ways to do it is still to be researched.

The surface-mass discipline relates to the earlier-mentioned analogy of putting rocks in the dough, as the case might have been in the pioneer days of sintering. As for "turning the oven off at the same time," that relates to much of the Quebec-Labrador concentrate being hematite instead of magnetite. The operating records at both the Erie and Reserve taconite plants in Minnesota show that about 28% of the total heat requirement for firing pellets comes from the exothermic reaction of the magnetite itself in transforming to hematite. The cost accountants there gratefully accept this as free manna from Heaven, but who is going to persuade the Labrador cost accountants to be equally broad-minded when the difference must be made up in purchased fuel? Nor can the added fuel be molecularly dispersed in the crystal lattice as the ferrous iron in magnetite.

BLAST FURNACE OUTLOOK

For those concerned with the blast furnace aspect of the new ore supply, O. R. Rice is required reading. He has no doubt—and leaves his readers none—that the blast furnace is on its way to all-time highs in both capacity and efficiency. He ventured to predict new U.S. furnaces of 4000-tpd capacity, as soon as adequately prepared high-grade raw materials could be made available, in keeping with recent advances in blast furnace technology. So swiftly has the raw materials outlook changed, that less than four months later, plans for a blast furnace in the Pittsburgh district were announced with such an orbit as its ultimate goal.

In our historical vein, the more telling points of the Rice analysis are that (a) blast furnace practice had remained an art for decades until an ore crisis intervened after World War II, (b) comparing 1959 with 1950, the percentage of beneficiates in the burden nearly trebled, along with marked increase in use of foreign high-grade ore, both duly reflected in a 15% decrease in slag volume, and (c) either as a coincidence or a result —or both—there was a great upsurge in enterprise to improve practice right at the very time we have defined as the end of the Era of Constancy.

The net outcome over the decade, according to Rice, was an increase of 26% in hot-metal production (from 1233 to 1550 net tons per furnace-day) and a decrease of 16% in coke rate (from 1747 to 1470 lbs per ton of iron).

These spectacular improvements were independent of the strong trend during the same period to furnaces of greater hearth diameter. Arbitrarily taking 25-ft diam and over as the definition of a "large" furnace, he notes that 56 out of the 239 U. S. furnaces existing in 1950, or 23%, were large by that measure. Their number, he says, had increased to 87 by 1959, or 35% of the new total.

It is instructive to look back at what H. S. Harrison had to say two years before Rice lit up the dark areas of the stage:

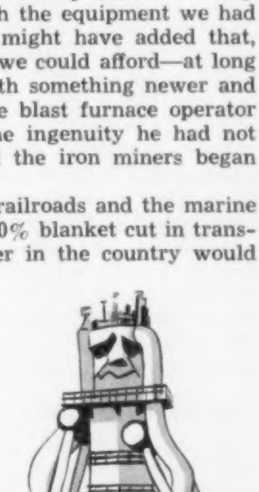
> "When an ore of 62% Fe replaces ore with 52% the production of a blast furnace will be increased by 20 per cent in iron analysis alone. If a company has five furnaces, in effect they have built a sixth if they use high-grade ore. Their labor costs will be correspondingly reduced because the same crew would be used to get the additional tonnage. It is as simple as that."

In this particular context, the Rice analysis reveals that Harrison wrought better than he knew, especially when Harrison went on to say that blast furnace capital costs have trebled and wages have quintupled, periods of comparison not stated.

Not to allow for blast furnaces getting bigger was his understandable omission. He expressed sorrow that the capital cost of a blast furnace has gone up, but if the productive capacity might increase in proportion, the capital cost per ton of capacity is the same. As for labor costs, even they are supposed to be geared to productive capacity.

In other words, Harrison was really right in saying that higher grade ore would permit us to stay within economic limits with the equipment we had at the time he wrote. He might have added that, with the higher grade ore, we could afford—at long last—to replace the old with something newer and bigger and better. Now the blast furnace operator can actually cash in on the ingenuity he had not even had to exercise until the iron miners began to get into trouble.

If at this same time the railroads and the marine carriers had announced a 20% blanket cut in transport rates, every newspaper in the country would have carried banner headlines on the front page. The reality is that such a cut has in effect already been made on high grade ore (though without the headlines), as will next be seen.



As Harrison might have said, an increase of 20% in Fe grade is 20% reduction in the cost of hauling iron units. Freight rates are fixed by the gross ton-mile. If the ton-in-the gondola or the ton-in-the-hold contains 62% Fe instead of 52% Fe, the cost of hauling a unit of iron has decreased by 20%.

After five decades of denying really robust health to blast furnaces due to silica, sulfur and phosphorus tapeworms, we now face the irony of too rich a diet. It has come to pass that the blast furnace is threatened with the equivalent of gout. On the ultra high-

grade burden, the problem is slag volume to scavenge the coke sulfur. For any ore having an iron to silica plus alumina ratio greater than about 14 to 1, a make-up slag would have to be produced by arbitrarily charging a ballast material in the form of silica rock or the like, plus a corresponding amount of additional flux stone.

In Table III, this Rice ratio is calculated for the individual ores and concentrate for which analytical data are available. It will be seen that: (a) there is no new problem on taconite or Ontario concentrate, whose ratios are in the range of 6:1 to 8:1. (b) Labrador concentrate is right at the critical limit at 13:1 or 14:1. This is the material of which an annual production of 20 million tons is already definitely planned, with more to follow. (c) In the new concentrate tonnage outlook, there is fairly substantial representation in the 30:1 range which would require "ballast," either as such or in the form of higher-silica ore from other sources. (d) Practically all of the impending tonnage of high grade overseas direct shipping ore is in the 20:1 bracket. Brazilian, Chilean, and Liberian ore would require dilution, just as Venezuelan does now. Wabush concentrate is too close to borderline to serve that purpose.

Thus, broadly speaking, the use of ultra-high grade ore or concentrate poses a queer handicap, almost as preposterous as the one referred to above in connection with pelletizing. There we saw that—unless research finds a better way—conventional pelletizing would require impending Labrador concentrate to be ground finer in order to agglomerate it into something coarser. In this impending grade situation blast furnaces face the need to add silica to the burden artificially, with extra lime to flux the extra silica and thereby cancelling out some coke-saving which the high grade aimed for. This is a wry reward for the beneficiation engineer who has spent a lifetime trying to take silica out of ore and put it on the dump where it belongs and which in the case of direct shipping ore Nature required a billion years to accomplish. A literal parallel would be to ask the oxygen people to put some nitrogen back into their beneficiated air.

As Rice makes clear, the slag volume is needed only as a vehicle to carry coke sulfur away from the iron. He cheerfully agrees that such a course would be followed only if a more sensible one cannot be found—which is exactly what the pelletizing people say about their problem, too.

COKE AND COAL CHEMICAL OUTLOOK

On the distaff side of hot metal (i.e., coal and coke), the once-in-a-lifetime change in iron ore source poses several problems. For present purposes, it will suffice to consider only two of them: (a) decreased blast furnace coke rate per ton of iron, and (b) sulfur tolerance.

There are no mysteries about the first, which reduces to the plain arithmetic of decreased coke and coal chemical production per ton of finished steel sold. Rice has already noted a 15% drop in coke rate in large furnaces, to 1470 lbs per ton of iron toward the end of the 1950-60 decade. With most of the big shift in ore grade still to come in the 1960-70 decade, he ventures the educated guess that coke rates might drop to 1000 lbs. It is of record that coke rates declined slowly but steadily from 1940 on, but the downtrend became sharply steeper in 1958 as the curtain rang down on the Era of Constancy. Politicians might say "there ought to be a law." The fact is that the iron miners are throwing many coal miners out of work.

Sulfur tolerance, as our second item, contains elements of suspense. The past record shows that for 30 years the percentage of sulfur showing up in metallurgical coke has remained essentially constant at about 60% of the gross sulfur in oven charge coal, the remainder being passed out with oven gas. (The sulfur content of blast furnace coke continues to range from 0.6% to 0.9%, depending on the coals in use). It is true that coal preparation methods have improved and that a much higher proportion of charge coal is now washed, but beyond the larry car, sulfur still follows the traditional distribution. Cumulative improvements in washing practice have reduced ash about in proportion to reduction in pyritic sulfur and hence have not increased the sulfur-carrying power of coke ash in the blast furnace. Both have about reached their limit. Indeed, in these respects we have been lucky to more or less hold our own in the face of inexorable increasing necessity to draw upon raw coals of higher and higher sulfur content after half of a century of skimming the cream of the coal mines.

Such research as has been done on modification of coking practice itself to reduce sulfur in coke has revealed certain technically feasible methods, e.g., hydrogen sweep, but not within permissible cost limits on the potential rewards in sight until now. On the customary iron ore mix of the past fifty years, there has been little incentive for such research.

This problem may not yet have been assigned due importance for the future since it had so little importance in the past with Upper Great Lakes ores always carrying their own built-in slag volume. Apart from external desulfurization of hot metal at the blast furnace or some artful twist at the coke plant, the only alternative is dilution by lower grade iron ore or higher ash coke—or gravel from yonder hill.

Iron ore contracts and pricing systems being what they are, that kind of dilution will certainly be practiced to a certain extent, and in fact already is. Nevertheless, the "blending off" of uneconomic ore is as fallacious as it is traditional, and is not limited to iron ores either. Contract wording is often a mutually agreeable disguise for an ore not intrinsically good enough to pay its own way. It is still in precisely the same position when mixed with a better ore. Fixed charges on marginally operating mines might justify such a practice if useful for slag volume purposes or base-acid balance, but purists will be pained and realists should be, at least until the next-century time when iron ore hunger starts to gnaw again.

CONCLUSION

When told in perspective, the story is one to make the old-timer proud that he was around to see most of it happen, beginning in 1892. By equal time measure, some young-timer considering the strides being made in gerontology—should be able in April, 2030, to report even greater accomplishments by his associates and immediate predecessors. But let us not extrapolate. By that time we may be getting artesian iron from Mohole.

A CONVENIENT MINE HOIST ANALYSIS

by ARTHUR W. BRUNE

Conventional methods of calculating the duty cycle of a mine hoist are awkward in that a number of items must be remembered or that they must be collected together in order to have all the calculated data in one place. A more convenient way is to tabulate all factors involved, permitting a ready evaluation of the problem.

An example illustrates the convenience of such a table for either of two types of drums, cylindrical and conical. Assume the following conditions: The hoisting depth is 600 ft. Balanced hoisting is used. The weights of empty skip and ore are 6000 lbs and 12,000 lbs, respectively. Production is 3600 tons per shift. Net hoisting time per shift is six hours with a rest period of eight sec, top and bottom, per trip. Acceleration and retardation are each six sec. The diameter of the drum is seven ft; its face is four ft. The sheave has the same diameter. The equivalent effective weight of the drum reduced to rope center is 15,400 lbs. The weight of each sheave is 2100 lbs.[1] The rope is 1¼-in. improved plow steel weighing 2.50 lb per ft.

The following symbols are used in the calculations: W, weight involved or weight or ore; W', equivalent effective weight reduced to center of rope; W_s, weight of skip; W_r, weight of rope on one side; T, time in which skip is actually travelling; V, velocity at full speed (fps); a, rate of acceleration or retardation (fps^2); d, hoisting distance (ft); g, acceleration due to gravity (32.2 fps^2); n, revolutions or turns; p, increase in conical-drum radius per revolution; r, radius of drum; t_a, time of acceleration; t_r, time of retardation; η, efficiency; ω, angular velocity (radians per sec).

CYLINDRICAL DRUM

We first calculate the trips per minute by:

$$\frac{3600 \text{ tons per shift}}{(6 \text{ hr per shift})(6 \text{ tons per trip})(60 \text{ min per hr})} = \frac{10}{6} \text{ trips per min, or 36 sec per trip.}$$

The hoisting velocity is:[2]

$$V = \frac{d}{T - \frac{1}{2}(t_a + t_r)} = \frac{600 \text{ ft}}{28 \text{ sec} - 6 \text{ sec}} = 27.28 \text{ fps.}$$

The drum speed is then determined to be

$$\frac{27.28 \text{ fps}}{7\pi \text{ ft per rev}} = 1.240 \text{ rps.}$$

The rate of acceleration is

$$\frac{27.28 \text{ fps}}{6 \text{ sec}} = 4.55 \text{ fps}^2.$$

The rate of retardation is -4.55 fps^2.

The number of active turns of the drum are

$$\frac{600 \text{ ft}}{7\pi \text{ ft}} = 27.28 \text{ turns.}$$

Now we may tabulate times and distances at each stage of the cycle (Table IA). A tabulation of suspended loads at each stage of the cycle is given in Table IB.

At the start of hoisting a loaded skip, 600 ft of rope are suspended from the sheave. At the end of 6 sec the drum has made 3.72 revolutions, winding onto it 81.8 ft of rope weighing 205 lbs. Thus the suspended load on the up-side of the hoist has been reduced to 19,295 lbs, whereas there has been lowered from the sheave 205 lbs of rope on the down-side so that the down suspended load has been increased from 6000 lbs to 6205 lbs. The other rope weights are figured in a similar manner.

In the summary tabulation (Table IC) the data from IA and IB pertaining to distance and suspended load or static pull are inserted. These figures can then be multiplied by the drum radius to produce the static moments whose difference must be obtained because the two loads tend to counteract each other.

Now it is pertinent to calculate the accelerating moments. On the "up" and "down" sides the moments are calculated by means of the formula:

$$\text{Load Acc Moment} = \frac{W}{g} r \cdot a.$$

The weight is the same on both sides except that the up side has 12,000 lbs of ore, while the down side has no ore. Additionally we must accelerate all the wire rope, not merely that which was considered in determining the suspended loads. There is on each side 216 ft of rope, 150 ft of which is from the sheave to the drum and the remainder being the snubbing wraps on the drum. Thus the weight on the up side is composed of: ore, 12,000 lbs; skip, 6000 lbs; active rope, 1500 lbs; dead rope, 540 lbs. Thus total weight on the up side is 20,040 lbs; on the down side, total weight is 8040 lbs.

By substituting the pertinent data from above into the formula, up side accelerating moment is 9910 ft-lbs; down side accelerating moment is 3980 ft-lbs.*

The accelerating moment of the rotating parts is obtained from:

$$\text{Rotating Acc Moment} = \frac{W'}{g} r^2 \frac{\omega}{t},$$

where t is the time of acceleration or retardation.

Assuming the unit to be a second-motion hoist, the $W'r^2$ of the gears is then 10% of that of the drum.[1] Assume further that the motor is equipped with a rotor having an equivalent effective weight at 1-ft radius of 3000 lbs, and that the hoist has a gear reduction of 8:1. $W'r^2$ of the rotating parts is:

Drum:	$(15{,}400 \text{ lbs})\ (3.5 \text{ ft})^2 =$	188,650 lb-ft^2
Gears:	$=$	18,860 lb-ft^2
Sheaves: each	$(2100 \text{ lbs})(3.5)^2 =$	51,450 lb-ft^2
Motor:	$(3000 \text{ lbs})(1 \text{ ft})^2\left(\frac{8}{1}\right)^2 =$	192,000 lb-ft^2
Total:	$=$	450,965 lb-ft^2

Thus, accelerating moment of rotating parts is

$$\frac{450{,}965 \text{ lb-ft}^2}{32.2 \text{ fps}^2} \times \frac{1.240 \text{ rps } (2\pi)}{6 \text{ sec}} = 18{,}180 \text{ ft-lbs.}$$

The efficiency η is obtained from:[1]

$$\frac{0.95W}{W - 0.04(W - 2W_s - W_r)} = 0.945.$$

The friction moment (M), constant throughout the running time of the hoist cycle, is

$$\frac{Wr(1-\eta)}{\eta} = 5950 \text{ ft-lbs.}$$

* Note that both accelerating moments have the same sign wherever they appear in Table 1C. The accelerating moments are positive during acceleration because all the weight must be brought up to speed, and the negative sign is applicable during retardation for the opposite reason. The accelerating moments are applicable from the start to the end of acceleration and throughout retardation, but not during full-speed operation.

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Table I. Cylindrical Drum

A. Time and Distance

	Time (sec)	Distance (rev)	Distance (ft)	Acceleration (fps²)	Velocity (fps)
Acceleration	6	3.72	81.8	4.55	—
Full Speed	16	19.84	436.4	0.00	27.28
Retardation	6	3.72	81.8	4.55	—
Rest	8	—	—		
Total	36	27.28	600.0		

B. Suspended Load (lb)

	From Rest to Acceleration		From Acceleration to Full Speed		From Speed to Retardation		From Retardation to Rest	
	U	D	U	D	U	D	U	D
Skip	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000
Ore	12,000	0	12,000	0	12,000	0	12,000	0
Rope	1,500	0	1,295	205	205	1,295	0	1,500
Total	19,500	6,000	19,295	6,205	18,205	7,295	18,000	7,500

C. Summary Data Sheet

		Acceleration		Full Speed		Retardation	
Distance (ft)	Up side	600		518.2		81.8	0
	Down side	0		81.8		518.2	600
Static Pull	Up side	19,500		19,295		18,205	18,000
	Down side	6,000		6,205		7,295	7,500
Drum Radius (ft)	Up side	3.5		3.5		3.5	3.5
	Down side	3.5		3.5		3.5	3.5
Moments Static	Up side	68,150		67,430		63,720	63,000
	Down side	21,004		21,720		25,530	26,250
Differential		47,150		45,710		38,190	36,750
Acceleration	Up side	9,910	9,910	0	0	−9,910	−9,910
	Down side	3,970	3,980	0	0	−3,980	−3,980
Rotating Parts		18,180	18,180	0	0	−18,180	−18,180
Friction		2,720	2,720	2,720	2,720	2,720	2,720
Torque (ft-lbs)		81,940	80,500	48,430	40,910	8,840	7,400
Horsepower (ft-lbs per sec)		1,161	1,141	686	580	125	105

The torque is the sum of the differential static, accelerating, rotating parts and friction moments. Power required at each stage is based on:

$$\text{Hp} = \frac{\text{Torque } (n \text{ radians per sec})}{550 \text{ ft-lbs per sec}}$$

$$\text{Hence, Hp} = \frac{\text{Torque } (1240 \text{ rps})(2\pi \text{ rad})}{550 \text{ ft-lbs per sec}}$$

$$\text{Hp} = 0.01417 \text{ Torque.}$$

Table IC contains all pertinent data about this particular hoist. The RMS-hp can then be calculated by conventional formulas.

CONICAL DRUM

Consider this situation to be identical with the first except that a conical drum is used. The small and large diameters are 6 ft and 8 ft, respectively. Certain items, in addition to those for the cylindrical hoist, must be calculated:

Equivalent or average full-speed time is

$$36 \text{ sec} - 8 \text{ sec} - \tfrac{1}{2}(6 \text{ sec} + 6 \text{ sec}) = 22 \text{ sec.}$$

Actual full speed time is

$$36 \text{ sec} - 8 \text{ sec} - (6 \text{ sec} + 6 \text{ sec}) = 16 \text{ sec.}$$

The number of active turns on the drum are

$$\frac{600 \text{ ft}}{2\pi \dfrac{(3 \text{ ft per rev} + 4 \text{ ft per rev})}{2}} = 27.28 \text{ turns.}$$

$$\text{Drum speed is } \frac{27.28 \text{ rev}}{22 \text{ sec}} = 1.240 \text{ rps.}$$

The following are the turns involved during

$$\text{Acceleration: } \frac{(0 + 6 \text{ sec})}{2} 1.240 \text{ rps} = 3.72 \text{ turns;}$$

$$\text{Retardation: } \frac{(6 \text{ sec} + 0)}{2} 1.240 \text{ rps} = 3.72 \text{ turns;}$$

Full speed: 16 sec (1.240 rps) = 19.84 turns.

The radial increase per revolution is:

$$p = \frac{4 \text{ ft} - 3 \text{ ft}}{27.28 \text{ rev}} = 0.0366 \text{ ft per rev.}$$

The drum radius at each stage of the hoisting cycle is calculated by means of:

$$r = r_3 + pn_a \quad \text{or} \quad r = r_4 - pn_r,$$

where the subscripts, 3 and 4, refer to the respective drum radii, and a and r refer to acceleration and retardation, respectively. Thus, on the up side, r at the end of acceleration is 3.136 ft; r at the start of retardation is 3.864 ft.

Likewise on the down side, the radius at the end of acceleration is 3.864 ft, and the radius at the start of retardation is 3.136 ft.

The distance involved at each stage is next determined. Up side, acceleration distance is

$$2\pi \frac{(3 \text{ ft} + 3.136 \text{ ft per rev})}{2} (3.72 \text{ rev}) = 71.7 \text{ ft.}$$

Up side, retardation distance is

$$2\pi \frac{(4 \text{ ft} + 3.864 \text{ ft per rev})}{2} (3.72 \text{ rev}) = 91.9 \text{ ft.}$$

On the down side, the distance involved during acceleration and retardation are 91.9 ft and 71.6 ft, respectively. The distance at full-speed operation is:

$$2\pi \frac{(3.136 \text{ ft} + 3.864 \text{ ft per rev})}{2} (19.84 \text{ rev}) = 436.4 \text{ ft.}$$

The rates of acceleration and retardation must be determined also. Up side, acceleration is

$$(2\pi) \frac{3.136 \text{ ft per rev}}{6 \text{ sec}} (1.240 \text{ rps}) = 4.07 \text{ fps}^2.$$

Table II. Conical Drum

A. Time and Distance

	Time (sec)	Distance (rev)	Distance U (ft)	Distance D (ft)	Acceleration (fps²) U	Acceleration (fps²) D	Velocity (fps) U	Velocity (fps) D
Acceleration	6	3.72	71.7	91.9	4.07	5.02	—	—
Full Speed	16	19.84	436.4	436.4	—	—	24.4	30.1
Retardation	6	3.72	91.9	71.6	−5.02	−4.07	—	—
Rest	8							
Total	36	27.28	600.0	600.0				

B. Suspended Load (lb)

	From Rest to Acceleration U	From Rest to Acceleration D	From Acceleration to Full Speed U	From Acceleration to Full Speed D	From Full Speed to Retardation U	From Full Speed to Retardation D	From Retardation to Rest U	From Retardation to Rest D
Skip	6,000	6,000	6,000	6,000	6,000	6,000	6,000	6,000
Ore	12,000	0	12,000	0	12,000	0	12,000	0
Rope	1,500	0	1,321	229	229	1,321	0	1,500
Total	19,500	6,000	19,321	6,229	18,229	7,321	18,000	7,500

C. Summary Data Sheet

		Acceleration		Full Speed		Retardation	
Distance (ft)	Up side	600	528.3			91.9	0
	Down side	0	91.9			528.3	600
Static Pull	Up side	19,500	19,321			18,229	18,000
	Down side	6,000	6,229			7,321	7,500
Drum Radius (ft)	Up side	3.00	3.136			3.864	4.00
	Down side	4.00	3.864			3.136	3.00
Moments							
Static	Up side	58,500	60,566			70,486	72,000
	Down side	24,000	24,052			22,966	22,500
Differential		34,500	36,514			47,520	49,500
Accelerating	Up side	7,615	7,926	0	0	−12,084	−12,525
	Down side	5,035	4,846	0	0	−3,188	−3,050
Rotating Parts		18,880	18,880	0	0	−18,880	−18,880
Friction		2,720	2,720	2,720	2,720	2,720	2,720
Torque (ft-lbs)		68,750	70,886	39,234	50,240	16,088	17,765
Horsepower (ft-lbs per sec)		975	1,005	556	11	28	252

$$\text{Up side, retardation} = (2\pi)\frac{3.864 \text{ ft per rev}}{6 \text{ sec}} 1.240 \text{ rps} = 5.02 \text{ fps}^2$$

On the down side the rates of acceleration and retardation are 5.02 fps² and 4.07 fps², respectively. The velocities are obtained by deleting the denominator of time (6 sec) from the equations for acceleration and retardation.

The summary of time and distance is in Table IIA.

Table IIB indicates the suspended loads or static pulls at each stage of the hoist cycle. When starting to hoist a loaded skip, 600 ft of rope are suspended from the sheave. At the end of 6 sec the drum has made 3.72 revolutions, winding onto it 71.7 ft of rope weighing 179 lb, while 91.9 ft of rope weighing 229 lb has been wound off the drum. Thus the static pull on the up side of the hoist has been reduced to 19,321 lbs, while that on the down side has been increased to 6,229 lbs. The other rope weights are figured in a similar manner.

The distances from Table IIA and the suspended loads from Table IIB are inserted into Table IIC, Summary Data Sheet; then the static moments are determined and inserted into the columns.

Using the equation for accelerating moments, we have at the start of acceleration:

Up side, accelerating moment = 7615 ft-lbs;

Down side, accelerating moment = 5035 ft-lbs.

At the end of acceleration, we have

Up side, accelerating moment = 7926 ft-lbs;

Down side, accelerating moment = 4846 ft-lbs.

Similarly, the accelerating moments are determined for both sides of the hoist at the start and end of retardation, the figures being shown in Table IIC.

Let us assume the $W'r^2$ of the drum and gears to be 225,000 lb-ft². Then accelerating moments of the rotating parts are determined in the following manner:

$W'r^2$ of rotating parts:

Drum and gears	= 225,000 lb-ft²;
Sheaves	= 51,450 lb-ft²;
Motor	= 192,000 lb-ft²
Total	= 468,450 lb-ft²

The accelerating moment of rotating parts is

$$\frac{468{,}450 \text{ lb-ft}^2}{32.2 \text{ fps}} \times \frac{1.240 \text{ rps}}{6 \text{ sec}} \times 2\pi \text{ rad per sec} = 18{,}880 \text{ ft-lbs.}$$

Friction moment M is obtained from the formula

$$M = \frac{(r_0 + r_1)}{2} \times \frac{(1-\eta)}{\eta},$$ and equals 2720 ft-lbs.

At the start of retardation, up side accelerating moment is

$$\frac{20{,}040 \text{ lbs}}{32.2 \text{ fps}^2}(3.864 \text{ ft})(-5.02 \text{ fps}^2) = -12{,}084 \text{ ft-lbs;}$$

On the down side, accelerating moment is

$$\frac{8040 \text{ lbs}}{32.2 \text{ fps}^2}(3.136 \text{ ft})(-4.07 \text{ fps}^2) = -3188 \text{ ft-lbs.}$$

Similarly, at the end of retardation, up side accelerating moment is −12,520 ft-lbs; down side accelerating moment is −3050 ft-lbs.

From the total moment or torque (i.e., sum of the differential static, accelerating, rotating parts and friction moments), the power requirement at each stage is calculated as follows:

$$\text{Hp} = \frac{\text{Torque } (1.240 \text{ rps})(2\pi \text{ rad})}{550 \text{ ft-lb per sec}} = 0.01417 \text{ Torque.}$$

Table IIC is similar to Table IC with data pertaining to the hoist neatly and compactly arranged.

REFERENCES

[1] R. S. Sage: Electric Drive for Mine Hoists. General Electric Co., GET-198A, 1949.
[2] R. S. Lewis. Elements of Mining, 2nd Edition, 1941, p. 210.

EXPLORATION OF THE KINGS MOUNTAIN PEGMATITES

by THOMAS L. KESLER

With only six small spodumene prospect pits, no detailed mapping, and no subsurface information in 1938, the Carolina lithium-pegmatite area now contains four mines among more than 25 properties on which exploratory work has been done. Even the open pit mine of Foote Mineral Co. described herein, from which ten million tons of ore and waste have been removed since 1952, was virgin ground when mapped in 1938-40[1]. It has been a privilege to participate in the transition.

In 1940, the spodumene pegmatites were known in a 25-mile belt (originally noted for tin prospecting) between Lincolnton, N. C. and Grover at the South Carolina line. Subsequently, Broadhurst[2] reported relatively small bodies northeast of Lincolnton near the Catawba County line. To the south, diamond drilling done in 1953 on the old Ross tin-mine property near Gaffney yielded pegmatite cores containing a few crystals of spodumene. This fact, not previously reported, suggests that some of the pyroxene in the Ross shaft as described by Sloan[3] may be spodumene.

The lithium pegmatites occur along parts of the east side of an irregular batholith known as the Cherryville quartz monzonite of probable Devonian age[4]. None have been found along the west side. Common quartz-feldspar (quartz-monzonite) pegmatites occur in and near the batholith, and even in contact with the lithium type. In fact, the spodumene and a few accompanying rare minerals constitute the main distinction between the two types, and a close genetic relation is beyond doubt. This is evident on the property shown in Fig. 2, with which this paper is concerned.

THE WALL ROCKS

The pegmatites are enclosed in metamorphic rocks of two types. One type is thin-layered amphibolite consisting mostly of hornblende and untwinned andesine. Epidote is common, and its predominance in many olive-green layers emphasizes the banded appearance of fresh faces. Quartz is of minor importance. Pyrrhotite and small knots of fine-grained garnet occur sporadically. Thin lenticular beds of marble are common in holes drilled in the amphibolite south of the Zero Section, (Fig. 2).

The other type of wall rock is mica schist consisting mostly of muscovite. Biotite, oligoclase and quartz are common; and garnet, staurolite, tourmaline, apatite, and pyrrhotite are unevenly accessory. The schist contains concordant layers of amphibolite and quartzite, and it is underlain stratigraphically by carbonate-silicate rocks and crystalline limestone that crop out east of the area shown in Fig. 2. These and other country rocks throughout the spodumene belt are more fully described in an earlier paper[5].

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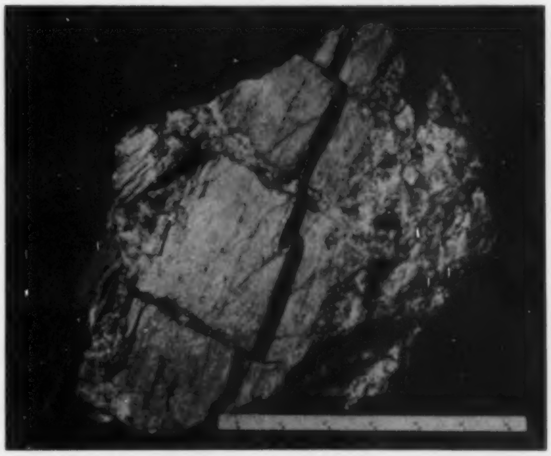

Fig. 1—Spodumene crystals with transverse fractures filled by albite and quartz. Six-inch ruler is in foreground.

WALL-ROCK ALTERATION

Alteration of wall rocks was of two types, one of which is important in relation to the origin and deep exploration of the pegmatites. A type directly attributable to the lithium pegmatites is found at many, but not all, contacts with amphibolite where the wall rock has been altered to coarse biotite schist grading into normal amphibolite within 2 ft or less from the contact. Biotite of this type was reported by Hess and Stevens[6] as containing these percentages:

Li_2O	1.20%
Rb_2O	1.85%
Cs_2O	0.47%

Holmquistite, a fibrous lithium-bearing amphibole averaging 3.5% Li_2O at Kings Mountain, is invariably present in these narrow zones. It is most abundant directly against the pegmatite where it commonly forms a thin selvage of violet-gray fibrous schist. It is accompanied by a little calcite and yellowish-green apatite.

The more important type of alteration occurs in widths up to 70 ft, near the pegmatites but not everywhere in contact. The rock is principally coarse biotite partly altered to chlorite. It is strongly mineralized with pyrrhotite and contains a little chalcopyrite (0.01 to 0.16% Cu). Fractured black tourmaline and holmquistite are present unevenly. The pegmatites contain no corresponding minerals excepting rare fragments of black tourmaline that appear to have been plucked from the walls. Residual blocks of amphibolite show that these biotitic bodies were originally amphibolite breccia. Drilling indicates that they pitch parallel with the largest body of pegmatite, and hence they are important to future exploration. Their origin involved a sequence of processes.

The first stage occurred before emplacement of the pegmatite. It included brecciation, alteration to biotite, and deposition of tourmaline. The absence of pegmatite indicates that the massive and diversely-oriented biotite had already formed, reducing permeability and sealing out the magma. That this biotite had a different origin from that in the narrow contact-alteration zones described above is further indicated by sharply lower rare-alkali content, as determined by J. M. Kishel through X-ray spectroscopy. The pure biotite contains only 0.15 ($\pm$0.015) % Rb_2O, and the total rock about 0.004 to 0.015%. For Cs_2O, all values are in the range 0.005%.

After emplacement of the pegmatite, fluids under pressure moving outward from the contact-alteration zones penetrated the altered breccias depositing the holmquistite. In a final stage, the sulfides were deposited and the biotite partly altered to chlorite. As sulfides are scare in the contact-alternation zones, and also cut pegmatite in rare veinlets, this final stage is not attributable to the pegmatite but probably to solutions from the deeper parts of the quartz monzonite.

This association between the pegmatites and older breccias probably accounts for the clustering seen in plan and section, the altered ground having the element of weakness that guided a tremendous amount of pegmatite upward within a small area, thus providing the opportunity for a large-scale open pit mining operation.

THE PEGMATITES

Size and Form: The cross sections in Fig. 3 show the pegmatites that underlie the open pit mine illustrated in Figs. 2 and 5 as well as the holes drilled in that area. The sections show that surface width may or may not approximate true thickness, depending upon attitude. The largest body, on the west side of the sections, has a fairly uniform thickness of about 200 ft at depths ranging from 150 to 500 ft below the present floor of the mine. This body is remarkable for its size and continuity. Other bodies shown in these sections range mostly between 20 and 100 ft in true thickness, and resemble the pegmatites in other parts of the property.

The eastern belt of mica schist shown in Fig. 2 contains the evenly west-dipping pegmatites seen on the east side of the sections, and the structural concordance reflects intrusion along the schistosity. Although these bodies are sharply controlled in strike and dip, no pitch element has yet been found. All other pegmatites in these sections were intruded into brittle amphibolite which broke without planar control. The largest body, on the west, has a northward pitch of nearly 20°, and the saddle-like body in the mid-area is essentially horizontal.

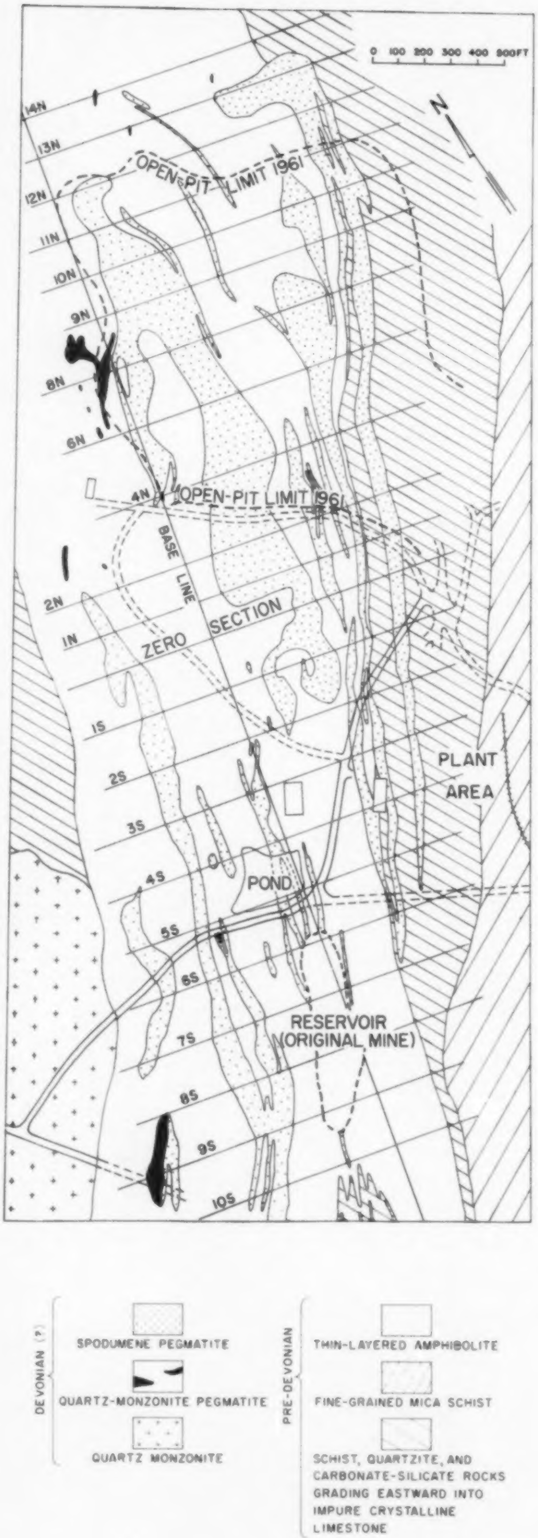

Fig. 2

Areal Geology of Foote Mineral Co. Mining Property, Kings Mountain, N. C.

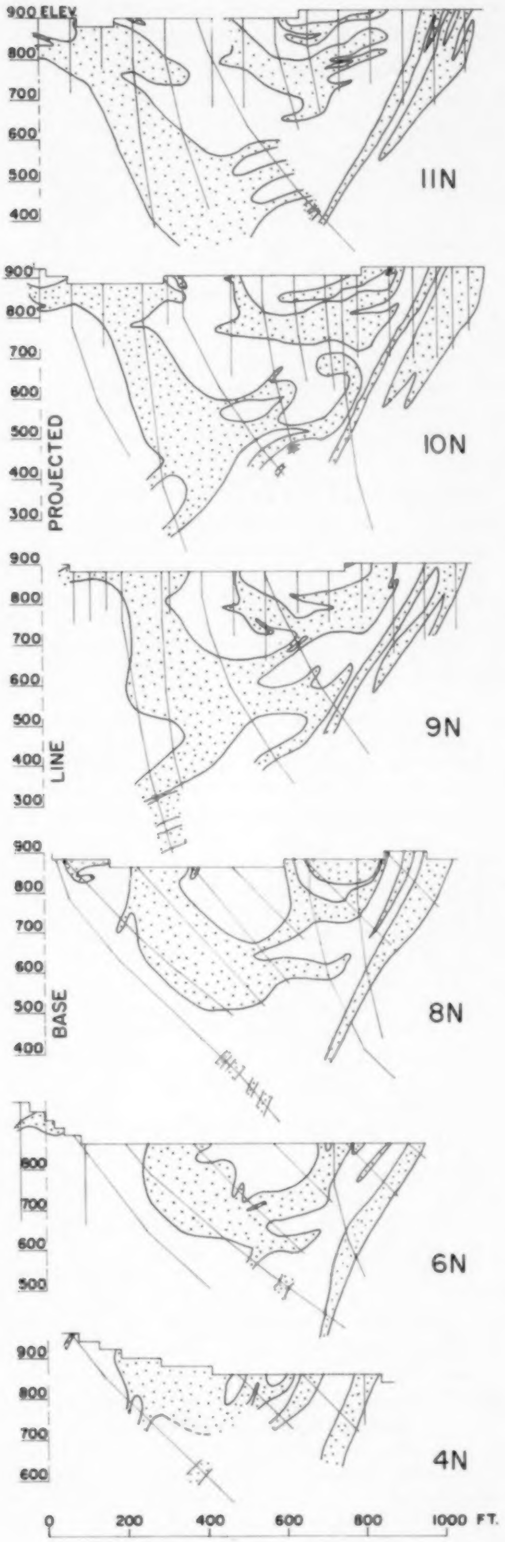

Fig. 3

Cross Sections of the Open Pit

(looking north)

Mineral Composition: The lithium pegmatites contain five minerals in more than trace quantities, and only two of them (spodumene and microcline) are of the coarse sizes usually associated with pegmatites. Essentially all of the rock contains spodumene, and all of it is milled. A systematic study of mill heads and mill products over many months of operation yielded the following weight proportions:

Mineral	Pct
Spodumene	20
Quartz	32
Muscovite	6
Feldspars (potash and soda varieties combined)	41
	99
Trace minerals (by difference)	1
	100

Crystals of spodumene and microline rarely reach three ft in length, and most are less than a foot long. The quartz is gray and finely granular except in random small bodies where it is massive and free of other minerals except spodumene. Only in such a matrix do the spodumene crystals approach euhedral form. The muscovite is yellowish-white and usually less than 1-in. in diameter. The soda feldspar actually includes a little medium-grained sodic oligoclase in addition to the abundant sugary albite.

The trace minerals are: 1) those intercrystallized with the commoner minerals, including dark-green apatite, fine glassy beryl, cassiterite, columbite-tantalite, montebrasite and sphalerite; and 2) those in thin veinlets that cut the pegmatites, including purple to pale blue-green apatite, rhodochrosite, pyrite, arsenopyrite, fairfieldite and the previously mentioned pyrrhotite and chalcopyrite. Supergene minerals are not discussed here, but the most conspicuous (and deepest) is water-clear vivianite that fills joints and oxidizes to a blue color soon after exposure to air.

Genetic Evidence: Any hypothesis of origin for the pegmatites must account for the internal features listed below. Paragenetic relations among the five common minerals are prominent, and no changes in depth have been found.

1) With minor irregularities, all of the minerals are distributed throughout the pegmatites. There is no systematic zoning except for a few inches at most contacts where spodumene and microcline are commonly absent.

2) Spodumene crystals are corroded and broken transversely, with the fine-grained albite and quartz of the enclosing matrix filling the fractures (Fig. 1). The mineral clearly is of early origin.

3) Microcline is essentially non-perthitic, fractured, healed by the albite and quartz, and also of early origin. Clear evidence of its relation to the spodumene has been found only twice, and in both instances it veins the spodumene and is therefore slightly later in origin.

4) Muscovite is of small flake size and is strongly twisted and of early origin. It is not aggregated as are the rare fine-grained muscovite pseudomorphs after spodumene.

5) The sugary texture of the albite and quartz is primary in the pegmatites and also in the adjacent wall rocks, which have been albitized in a few places in thicknesses up to 12 ft. The albite and quartz are everywhere intergrown and of contemporaneous origin. The smaller amount of oligoclase is earlier than the albite but later than the microcline.

6) Albite and quartz compose about 60 pct of the pegmatite rock, forming the fine-grained matrix of all the other minerals. As an integral part of the pegmatites, this matrix might be described as aplitic, but not as aplite.

Fig. 4—Exposure of amphibolite fault rubble between pegmatite walls. The hanging wall is strongly brecciated.

7) Of the intercrystallized trace minerals, the cassiterite, columbite-tantalite and beryl are characteristically fractured and are apparently early. The apatite and sphalerite accompanied the sugary albite and quartz, corroding earlier minerals.

These features indicate sequential crystallization without segregation, but the predominant role of solutions originally proposed[1] is not substantiated by the extensive exposures of sharp contacts, discordant except in the mica schist. In fact, the essentially homogeneous internal structure and limited contact alteration argue for low volatile content and weak mobility of constituents during crystallization.

The pegmatites were intruded as magma, and crystallization began at least with the microcline stage. The deposition of feldspar and quartz from solutions was limited mostly to the small bodies of albitized wall rocks, whose preserved layered structure reflects replacement. By analogy, local layered parts of the pegmatites may be similarly replaced inclusions.

Origin of the spodumene itself is still in doubt. Although the crystals are everywhere broken into segments, the segments remain adjacent. The crystals were therefore supported when broken, but the enclosing quartz and feldspar fill the breaks and are therefore younger than the deformation. Perhaps the spodumene crystallized from non-flowing magma viscous enough to give support but, where spodumene and quartz-monzonite pegmatites adjoin (Fig. 2), the quartz and feldspars of the two are coextensive, indicating a single intrusion that should have mixed the lithia as thoroughly as in the larger bodies.

POST-PEGMATITE FAULTS

The pegmatites and their wall rocks are cut by nearly vertical transverse faults. Strong fracturing and brecciation of adjacent amphibolite and pegmatite occur in many places, particularly in narrow zones separating parallel faults. Most of the structures, even where they cut pegmatite, contain less than a foot of compact biotite resembling minette. Greater widths of this material show the biotite to be an alteration product of amphibolite fault rubble, blocks of the latter being enveloped in the biotite (Fig. 4). The strongest fault found to date strikes N 83° W between Sections 8N and 9N. It has been intersected by four drill holes down to the 425-ft elevation, and it dips 83° north. The displacements are insufficient to offset contacts shown on the map, or to affect mining.

EXPLORATION PLAN AND METHODS

Exploration and mine surveying are controlled by a triangulation net from which geologic mapping is expanded by plane table at 80 ft per inch. Original mapping included topography, now largely obscured. Contacts in the open-pit area in Fig. 2 are as of 1959 to match the sections (Fig. 3) plotted at the close of the last exploration program.

Diamond drilling, computation of reserves, and mine planning are based on the cross sections normal to a base line bearing N 14° E. The sections are arranged in two groups, north and south of a Zero Section. The north group controls the open pit and includes uneven section intervals fixed by early drilling. On each section line, holes are numbered in the order drilled (i.e., 9N18), and location is expressed in feet east or west of the base line (i.e., 562E).

AX is the minimum core size used. In weathered ground, holes are started at BX or NX size to avoid reaming or cementing. Inclined holes drilled in 1943-44 were checked for inclination. Vertical holes drilled in 1952 and 1954-56 were mostly shallow for immediate open-pit planning. Vertical and inclined holes drilled in 1959 were surveyed by Tro-Pari instrument with inclination checked by the acid bottle technique.

Core recovery is poor within about 40 ft of the surface due to weathering, and exceptionally deep kaolinization is exposed to a depth of 80 ft in the south wall of the pit. Only three narrow pockets of similar alteration have been cut at greater depth, the deepest one being at 725-ft elevation. Elsewhere, core recovery is essentially 100 pct in pegmatite and about 85 pct in the wall rocks, but losses are not evenly distributed. Close jointing in the amphibolite yields wedge-shaped fragments that cause blocking

Table I. Mineral Composition of Kings Mountain Pegmatite

Mineral	Pct by weight in Pegmatite	Avg Li_2O in Mineral, pct	Avg Li_2O in Pegmatite, pct	Pct by weight of Total Li_2O
Spodumene	20	7.46	1.492	97.6
Microcline (potash feldspar)	14	0.12	0.017	1.1
Albite (soda feldspar)	27	0.01	0.003	0.2
Quartz	32	0.02	0.006	0.4
Mica (muscovite)	6	0.19	0.011	0.7
Trace minerals	1	—	—	—
	100		1.529	100.0

Table II. Chemical Composition of Selected Mineral Samples from Kings Mountain

	Albite	Microcline	Muscovite
SiO_2	68.51	64.13	44.05
Al_2O_3	20.21	20.70	36.95
Fe_2O_3	0.004	0.069	(Fe) 1.76
MgO	0.10	0.12	0.09
CaO	0.028	0.029	—
K_2O	0.07	12.70	9.50
Na_2O	10.89	1.94	1.01
Li_2O	0.01	0.12	0.19
TiO_2	0.008	—	—
Ign. Loss	0.17	0.38	—
	100.000	100.188	93.55

Fig. 5—The open pit mine at Kings Mountain is worked in 20-ft benches. Seven benches have been developed to date.

in the barrel, and 20-ft long double-tube rigid assemblies are generally used.

SAMPLES AND ASSAYS

Cores are logged for lithology and structure of pegmatite and wall rock, and this information is plotted on the sections while drilling is in progress. Tests for radioactivity over a two-year period were negative. The sample interval in pegmatite is 10 ft or nearest practical interval. All of the pegmatite core is crushed, as the spodumene is too coarse and diversely oriented to yield equal halves. About 5 lbs of minus-¼-in. ore from each 10-ft run is filed for future use. Lithia assays are made by flame photometer, and many spectrographic analyses have been made for Be, Sn, Cb and Ta.

Assays were formerly made on each sample, but, in view of the laboratory load and general distribution of the spodumene, splits from adjacent samples are now combined for 20-ft assays. The work involved is indicated by the fact that 38% of all the footage drilled to date (49,700 ft) has been in ore. There have been 37 ore penetrations exceeding 100 ft each and ranging from 106 to 445 ft of uninterrupted ore. Specifically, there have been 1165 core assays by flame photometer and 1093 earlier assays by other methods.

GRADE OF THE ORE

Distribution of Lithia: Table I shows the Li_2O content of the different minerals based on present data. The resulting average grade of ore (1.529% Li_2O) agrees with the weighted average grade of the measured ore reserve in Table III (1.53% Li_2O). The weighted average grade of all ore milled in the seven-year period 1954-1960 is 1.56% Li_2O.

Parts of the cross sections (Fig. 3) are shown in larger scale in Fig. 6 with assay intervals plotted on the drill holes. As Table I shows that Li_2O is present almost entirely in spodumene, the assays in Fig. 6 accurately reflect the distribution of spodumene in the pegmatites. There is no special feature involving spodumene that persists vertically or horizontally for any appreciable distance and consequently the pegmatites are mined wall-to-wall without wide fluctuations in grade.

Current Byproducts: Besides spodumene, the principal ore values are in feldspar and mica, both of which are being marketed. As Table I indicates, the ratio of soda to potash feldspar is 2:1. Together they equal 41%, by weight, of the ore and are milled in recovering the spodumene. Analyses of selected samples of the pure minerals are given in Table II, which also includes an incomplete analysis of the mica. Production of these products will determine the marketable supply of silica.

Other Values: Spectrographic analyses of the ore range primarily between 0.005 and 0.02% Cb_2O_5, and between 0.001 and 0.004% Ta_2O_5. This indicates about 0.008 to 0.03% columbite-tantalite unless parts of these oxides are in the nonmetallic

Table III. Summary of Measured Ore Reserves* for the Area Shown in Fig. 2

Cross Section	Gross Ore (tons)	Li_2O, Weighted Avg
13N	470,209	1.38
12N	1,615,644	1.25
11N	2,746,639	1.44
10N	3,011,172	1.61
9N	3,217,806	1.47
8N	2,784,222	1.63
6N	2,168,489	1.57
4N	1,406,031	1.40
2S	444,444	1.49
3S	194,188	1.62
4S	481,368	1.51
6S	466,325	1.69
7S	846,769	1.69
8S	892,901	1.86
	20,746,297	1.53

* Computed June 30, 1959.

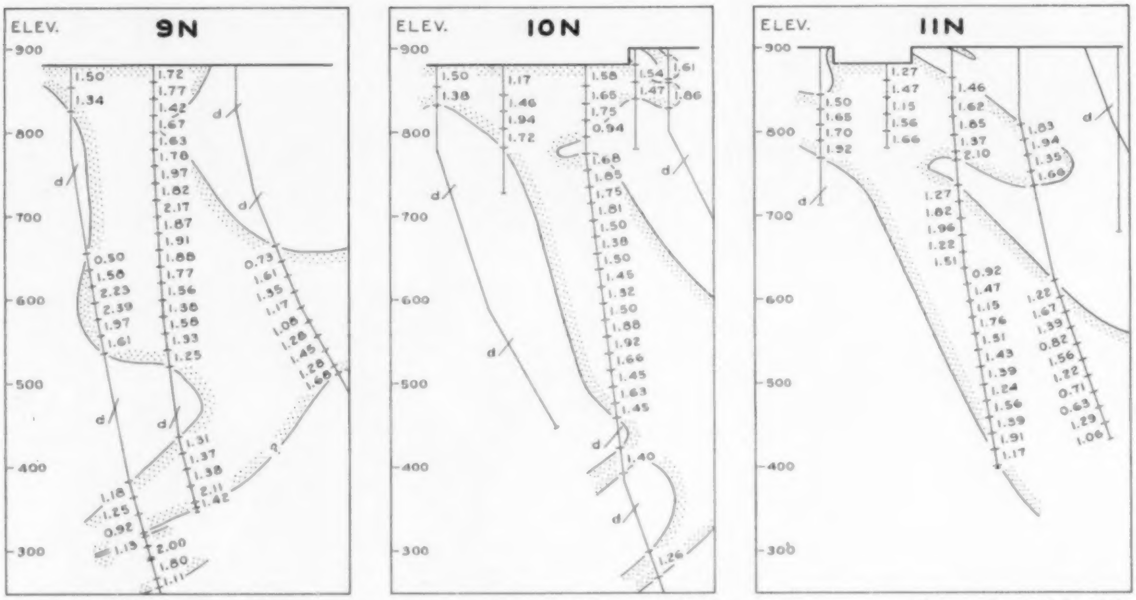

Fig. 6—Lithia assays in parts of cross sections shown in Fig. 3. The dip of the country rock is indicated by "d".

minerals. The spodumene is known to contain chemically 0.063 to 0.15% SnO_2 but not as cassiterite.[7] Thus, although assays have shown 0.002 to 0.02 Sn in the ore, little of this could be present as cassiterite, which is extremely scarce except in the small and local deposits previously described[1].

The writer discovered in 1940 that the lithium pegmatites contain fine-grained disseminated beryl almost impossible to recognize in broken ore but easily identified microscopically in index liquids. A detailed study of its occurrence was reported in 1954 by Griffitts[8] who determined 0.05% as the average BeO content, of which at least 80% is in the form of beryl. Assuming that 90% or 0.045 BeO is in beryl, and that 12% BeO is pure beryl, the indicated average beryl content of the pegmatites is 0.375 %. This would amount to a gross content of 77,800 tons of beryl (9300 tons of BeO) in the ore reserves shown in Table III, without allowance for mine and mill recoveries. The U. S. Bureau of Mines is operating a pilot plant to test beryl recovery[9].

COMPUTATION OF RESERVES

Each cross section controls an ore reserve segment extending across all of the pegmatites and as deep as ore has been drilled. The influence of each section extends half way to adjacent sections, and the sum of its planimetered end areas of ore is multiplied by segment width and converted to tonnage at 11.7 cu ft per short ton. Weighted average of all its core assays determines average grade of each section, and the sum of the sections with grade weighted according to their proportionate tonnages equals the measured gross ore reserve. Table III summarizes this reserve as recomputed in 1959 at the end of the latest drilling program. Indicated ore is computed beneath and between measured-ore blocks wherever justified by drilling and geologic evidence, and it amounts to an additional 15 million tons. The total is more than one-third of the 99 million tons of spodumene ore estimated in 1960 from available data on world resources.[10]

Open pit mine planning is based on 20-ft benches (Fig. 1) that intersect alternate blocks of ore and waste in each cross section. Each block is computed separately, less a 2-ft dilution allowance at every ore contact. In this process, pegmatite with less than 10-ft bench width is not included with the ore. An inventory system for recoverable ore and incident waste records the data and tonnages per bench for each cross-section area of influence, and per bench throughout the mine area. Sums of these tonnages for all the benches equal total waste and recoverable ore. The ratio of waste to ore in the current 10-bench (200 ft) plan is 2.54:1, including the entire zone of weathering.

OUTLOOK FOR EXPLORATION

New exploration will concentrate on two favorable areas. One involves the large pegmatite on the west side of the south sections, where limited drilling has shown above-average grade (Table III) and good thickness at depth. The other area is in the sections north of 8N where the great depth of pegmatite and associated altered breccias strongly indicates a center of steep ascent for pegmatite magma. This probability is supported by drilling beyond the north end of the pegmatites, which has shown that their low-angle pitch ends abruptly with the outcrops. These features outline the target area for future deep drilling to block ore for underground mining which, fortunately, is many years removed.

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PRESENT STATE OF COAL FLOTATION IN WEST GERMANY

Spurred by a variety of factors, coal flotation is making headway among the preparation plants of West Germany. Mr. Sallmann provides a general view of flotation practices being employed in his country, with special emphasis on the many-sided problems that confront German coal preparation engineers.

by KARL SALLMANN

The coal mining industry of Western Germany is concentrated in three coalfields: the first on the Ruhr and the Rhein rivers, the second on the Saar river, and the third near the frontier between Germany and the Netherlands, around the towns of Aachen and Erkelenz. The total run-of-mine production of these three coalfields amounts to 736,000 tpd which come from 145 collieries. There are 121 washeries, 43 of them with a flotation plant. The total throughput of these 43 washeries is 280,000 tpd, out of which 26,000 tons (9.3% of the washery feed coal) are cleaned by flotation. The capacity of the individual flotation plants varies within relatively wide limits, the average being 40 tph and the capacity of the largest flotation plant being 120 tph.

During the last few years, the number and size of flotation plants have been steadily increasing, although flotation must be looked upon as an expensive and rather complex cleaning process. The considerations which have lead to the widespread application of flotation may be summarized as follows:

1) In making coking coal, it is seldom possible to add uncleaned fines to the coke oven charge as their ash content is too high. If, however, the ash content of the fines is reduced to a maximum of 7 or 8%, they can be admixed to the washed and crushed small sizes without difficulty. This means, naturally that revenue is increased since the price of coking fines is always higher than the price for dust or uncleaned wet fines.

2) To prevent silicosis and pneumoconiosis, water infusion and spraying of the coal are practiced much more today than ever before. As a result, moisture content of run-of-mine coal has markedly increased and the washery feed coal contains more and more slurry instead of dry dust. The price of slurry, however, is very low, and in many cases it is impossible to sell filtered raw slurry with a moisture content of 20 to 25% and, at the same time, 20 to 25% of ash. Reduction of the ash content of these slurries improves the possibility of dewatering them and, in this way, also enhances the marketability of this product.

3) The new severe laws and regulations against pollution of air and rivers make it necessary to dedust coal better than in the past and to reduce the quantity of the waste water from coal preparation plants and their solids content to a minimum.

4) Even if there were no compulsory reasons to clean the fines, flotation will often lead to an increase in the overall yield.

Although not the only application, it appears that the treatment of coking fines is the primary field for the flotation process in coal preparation. It must not be overlooked, however, that a series of arguments may be advanced against flotation:

1) Flotation is an expensive process because, in addition to the cleaning operation itself, the dewatering of the froth and the disposal of the tailings is very costly.

2) Operation of a flotation plant requires well-trained personnel.

3) Filtered froth has about a 20% moisture content and, therefore, if mixed with the cleaned small coal it causes an undesirable increase in water content of the coke oven charge. For this reason it is necessary to take additional measures for dewatering washed small coal and this, of course, entails additional expense.

4) Disposal of flotation tailings involves very difficult problems, particularly in highly industrialized regions.

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An investigation covering 32 flotation plants of Western Germany shows the following composition and properties of their feed:

	Maximum (Pct)	Minimum (Pct)	Average (Pct)
Volatile matter (water and ash-free)	38.7	21.2	29.9
Ash content	32.9	9.7	20.5
Grain size over 0.75 mm	13.1	0.0	3.9
Grain size below 0.10 mm	70.7	11.6	34.6
Ash content of size fraction over 0.75 mm	21.2	2.7	8.5
Ash content of size fraction below 0.10 mm	47.5	18.3	31.1

The figures for volatile matter content show that in most of the flotation plants, the fines to be cleaned are desirable for coking coals. However, the ash content of the fines in most of the collieries examined is about 20%; thus it would be impossible to admix the uncleaned fines to the washed coal fines. As for the size consist, the feed to the flotation plants is composed of grains from about −0.75 mm, with the particles of minus 100 microns predominating. Furthermore, the table shows that the ash is concentrated in the finest size fractions. This is partly due to the fact that the feed to the flotation plant is usually sized in a current of water rather than screened. In this way, the coarser and heavier shale particles will pass into the coarse slurries, whereas the lighter coal particles and the slimes are concentrated in the feed to the flotation plant.

Flotation cells used in most of the older plants of Western Germany are similar to the standard cell of Minerals Separation Ltd., apart from some smaller modifications. The latest type of this machine is equipped with froth overflow launders on both sides. Other cells with double-sided discharge and generally designed like the Fahrenwald cell, are also being used in Germany.

To judge from the results, the differences between the two types of cells is not substantial. If the grain size of the feed is very fine, which entails a tendency of the slimes to float with the coal, the standard cell is given preference; one obtains a purer froth, together with tailings of a lower ash content. The Fahrenwald type, by contrast, seems to be more suitable for coarser slurries. Its vigorous agitation effect leads to tailings with a very high ash content at the expense of the cleanness of the froth. The volume of the cells range in most cases to about 106 cu ft, although one washery has large cells with a capacity of 176.5 cu ft.

The success of a flotation plant depends essentially on its method of operation which, in turn, is subject to the properties and the composition of the feed.

As a rule, the solids content of the pulp in German flotation plants is less than some years ago. In most cases the solids concentration in the first cell is kept at less than 200 grams per liter and often at 100 grams per liter. This is because the slurry in most cases contains a greater amount of fines and slimes than before due to the higher moisture content of the run-of-mine coal. It is generally known that these fine slimes are better eliminated if the solids content of the pulp is kept low and if the reagents used do not produce too strong a collecting effect.

The most commonly used reagents are coal tar derivatives manufactured so as to keep their content of acid components, mostly phenols, as uniform as possible. Large quantities of these standardized reagents are commercially sold. They are easy to apply, and in practice, they have proved better than the former mixtures of different oils which had to be made up in the plants.

It is known that the acid components will act as collectors but unfortunately, they are poisonous and conflict with the increasingly severe regulations against river pollution. The chemical manufacturers are trying, therefore, to produce flotation reagents free from phenols; some of them have already appeared in the market. They are less expensive than the usual flotation oils but it is claimed that they are equal to them as frothers and collectors. Large-scale experience with these chemicals, however, is still absent.

WATER RECOVERY

There is one other point which needs being mentioned, namely, the reuse of the water after the dewatering of the froth and the tailings. The recovery of this water becomes more and more a necessity since, with the concentration of the industry in Western Germany, it is extremely difficult to meet the demands for water. Fortunately, the chemical industry has many water clarification agents that do not affect the flotation process.

The higher the proportion of the filter cake added to the washed fine coal, the more important is the dewatering of the froth. This is true especially in the case of coking coal. Up to now the most common process of dewatering froth is the traditional method using vacuum drum or disc filters. By means of modern drum filters with variable speed and a suitably formed surface, a high degree of efficiency is achieved. In many cases a moisture content of less than 20% is realized with a specific throughput up to 0.07 tons per sq ft.

It has been observed that the specific throughput of the filters is increased if the filter itself is preceded by a vacuum froth destroyer. Much in favor in Germany are flocculation agents which have the twofold effect of increasing the specific throughput and of reducing the final moisture content, provided that they are added in right proportions-approximately 100 grams per ton of solids to be filtered.

Bronze or stainless steel filter cloths still predominate with vacuum filters. Plastic cloth, though rather attractive because of its hydrophobous surface, proved a failure in many cases due to insufficient mechanical strength. Disc filters, however, are frequently operated with filter bags made of perlon, saran and similar synthetic material. The throughput capacity of the filter can be increased by thickening the pulp.

A satisfactory method of dewatering froth in centrifuges has not yet been found. Tests in this direction are being made, but it would be premature to derive conclusions. For seven years, Eschweiler Bergwerks Verein has been operating a bowl centrifuge in one of its washeries. With two baskets, each with a diameter of 100 in. and a useful width of 28 in., this centrifuge handles 15 dry tons of froth per hour. If the sieve cloth is covered with a layer of small coal prior to centrifuging, it is possible to reduce the moisture content to about 15%. The great disadvantage of this machine is the high content of solids in the filtrate, about 60 grams per liter. As the drainage and recovery of these extremely fine-grained solids are very difficult, the advantage

of the excellent dewatering effect of the centrifuge is lost to a great extent. Other types of centrifuges with sieves give similar results. Attempts are being made, therefore, with solid bowl centrifuges, but they apparently have not been a convincing success.

TAILINGS POSE PROBLEM

The problem of most concern to German flotation engineers is the disposal of tailings discharged in a pulp containing 40 to 50 grams of solids per liter, 80 to 90% of which are smaller than 100 microns. Only a few collieries are fortunate enough to have at their disposal settling ponds into which tailings can be impounded for dewatering. In addition, the method of excavating dewatered tailings is hardly an economic proposition because, not only the excavation itself is expensive, but also there is usually no place to dispose of the partly dewatered product.

In view of the enormous space requirements of the ponds and the expensive work of excavating them, great efforts are made to dewater the tailings as cheaply as possible without a need for large space. Thickeners which bring about a concentration up to 600 or 700 grams per liter are not sufficient for this purpose. Attempts have been tried to pump such a thickened underflow onto waste heaps, but it was difficult to mix it evenly with the washery refuse. Watery zones and rills formed, threatening the consistency of the waste heap and detrimental to the formation of a stable slope.

Dewatering of thickened tailings in filter presses, commonly used in Great Britain, has not found widespread application in Germany. In fact, it seems too expensive, mostly in view of the low throughput and high cost. In spite of this, manufacturers of filter presses are making great efforts to design fully or semi-automatic filter presses, and it is possible that the future will lead to success in this field.

Tests are also being made with centrifuges, but because of the fineness of the material, the only type holding a prospect of success is the solid bowl centrifuge. The tailings can be dewatered to a moisture content of 30 to 35% and, in exceptional cases, even less. But this product is still too fluid, for it sticks to rubber belts and to the walls of bin wagons.

A partial solution to the problem is the old method of running tailings into a settling basin where the coarser particles will settle and be discharged by means of a perforated bucket elevator. The sandy material discharged from the buckets can be admixed to the washery refuse without difficulties, but the disposal of the sump overflow still remains a problem.

Recently this method has been markedly improved. A new plant has been put into operation recently at the Emil Mayrisch colliery near Aachen, and only time will determine how the new method will affect the behavior of the waste heap. Reagents with a very high flocculating effect are added to the tailings in a very large settling tank. Most of the solids are flocculated and will settle. They are discharged by means of an elevator whose buckets are lined with a 2-mm sieve cloth. The coarse tailings discharged from these buckets are mixed with broken washery refuse, at a ratio of 1:1 up to 1:2.* The resulting product discharged from this mixer is a crumbly mass which can be transported without difficulties to the waste heap by belt conveyor. The efficiency can still be improved by addition of fly-ash or similar material.

*The overflow of the settling tank runs into a thickener; its underflow, with a very high solids concentration, is pumped into the mixer.

Whatever the method of tailings disposal, the costs are always very high and can equal or even exceed the cleaning costs. Other efforts are being made, therefore, to improve the economy of the flotation plants by transforming the tailings into useful products. It has been proposed to make cement or bricks from tailings of suitable chemical composition, but these attempts were given up after the first stage of the experiments because the products obtained were not competitive in the market. Recently, tests have begun with a view to sintering the tailings and making cinder blocks from the very hard, slaggy sintered material. This process is still under trial.

It has been proposed to run flotation plants in such a way that they produce a very clean concentrate and tailings with an ash content not exceeding 40% which could be used as boiler fuel. In such a case it would be possible to stockpile the tailings but the loss of cleaned coal would be so high that the whole process would no longer be economic.

COST OF COAL FLOTATION

In conclusion it seems appropriate to mention the costs of flotation in Germany. The figures are given in German currency since conversion of Deutsch Marks into dollars using the official rate of exchange would not lead to comparable figures because of the different cost factors (e.g. wages are certainly not the same in the U.S. as in Germany).

The figures in the table have been calculated partly from the results obtained in the 32 German washeries mentioned at the beginning of this paper and partly in the light of the latest experience. All figures are on a dry basis.

Costs of Coal Flotation in Western Germany, 1960

	Cleaning[1]	Treatment of Froth[2]	Tailing Disposal[3] (in ponds)
Total Costs in DM per ton	1.27	1.26	5.41
Contributing Cost Factors (Pct of Total Costs)			
Capital expenditure including interest, depreciation	21.2%	20.6%	19.2%
Labor	13.4	11.9	64.0
Power Consumption	27.6	43.7	9.8
Reagents	23.6	9.5	3.1
Other material	9.5	4.8	—
Maintenance	4.7	9.5	3.9
	100.0%	100.0%	100.0%

[1] Covers costs of transportation of feed pulp, conditioning, addition of reagents and operation of flotation cells.

[2] Includes cost of transportation of froth from flotation cells to the filters and operation of the filters and addition of reagents.

[3] Costs calculated on basis of dewatering in settling ponds and excavation of contents. As a rule, excavation of settling ponds are done by contractors; cost for this work is included in "Labor" which accounts for the high percentage of total costs for tailings disposal. According to available data, costs of other methods of tailings disposal are as follows: filter presses, DM 8; solid bowl centrifuges (which do not produce final products), DM 2; settling basins with bucket elevators and tailings mixed with crushed washery refuse, DM 3.

As a rule, 100 tons of feed to the flotation plant will be split approximately into 80% concentrate and 20% tailings by weight. Using this proportion as a basis, the total cost per ton of feed to the flotation plant is DM 3.36.

Although problems still remain to be solved, the present state of coal flotation in Western Germany gives promise for the future of that nation's coal industry.

MISSION MINE GOES TO WORK

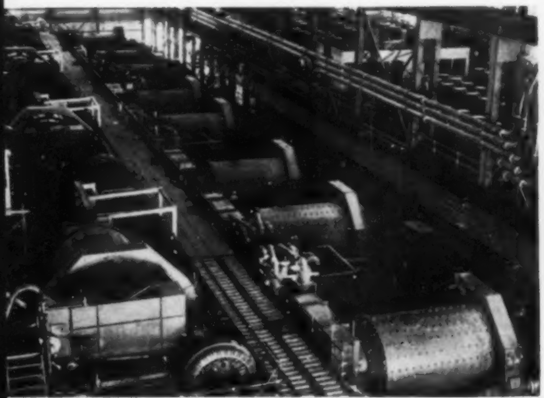
On July 25, the first copper ore from American Smelting & Refining Co.'s Mission open pit mine was sent into the new 15,000-tpd concentrator; three days later, the first rail cars containing the Mission concentrate were sent north to the smelter at Hayden, Ariz. Thus two years after stripping was started, Asarco's new mine, located south of Tucson, went on stream several months ahead of schedule. The plant, designed and constructed by Western Knapp Engineering Co., is expected to be operating at full capacity about September 1, with present plans calling for the copper concentrate from Mission to be shipped to Asarco's smelters at Hayden and El Paso.

Pending completion of the concentrator, 250,000 tons of mine ore were stockpiled (upper right). At top center is primary crusher; from upper left to center is coarse ore storage, secondary crusher plant, and main plant.

Fifty-five ton trucks carry ore to primary crusher. The major copper mineral is chalcopyrite. Ore grade is confined to folded and faulted hornsfel, tactite and argillite rock types that were intruded by a monzonite porphyry.

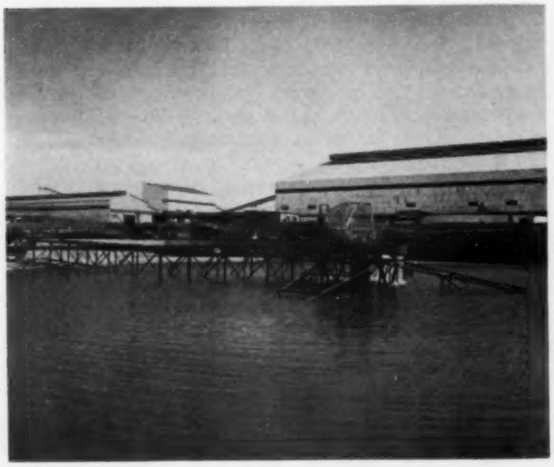
Primary crushing at Mission is done in a 54-in. gyratory crusher equipped with replaceable wear plate sections. Run-of-mine ore from the 250-ft deep open pit is reduced to 6-in. size and sent to the coarse ore storage.

From the coarse ore storage (shown above), ore goes to a secondary crusher plant located between the stockpile and the main plant. The material then goes to a fine ore stockpile which has a nominal capacity of 15,000 tons.

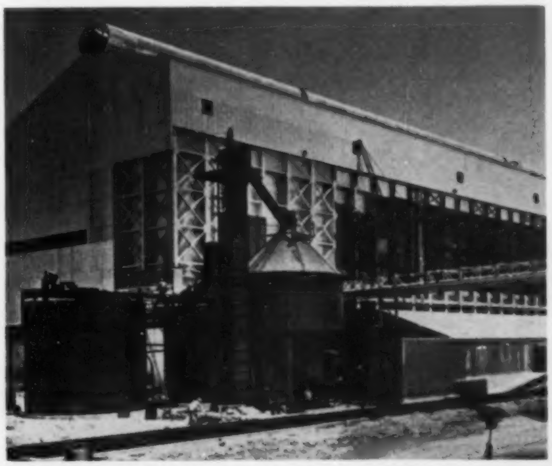


Grinding section (left) has four 10½ x 15-ft rod mills, eight 10½ x 15-ft ball mills recirculating through cyclones, and two 7-ft regrind mills. The copper flotation process (right) is divided into two halves, each operating independently of each other.

The concentrator has two 275-ft diam tailings thickeners from which tailings are sent by gravity one mile to the tailing dump. New process water for the plant is obtained from wells about five miles east of Mission.



Last major construction project was the lime and reagent storage area and the concentrate filtering and handling facility located adjacent to the concentrator and rail siding. Estimated cost of Mission Project is $43,500,000.



PREPARING MEN FOR MINING'S FUTURE

by EVAN JUST

The mining industry is guaranteed an important future because its products are indispensable. However, this can be anything from a brilliant, efficient, profitable future to one of being a heavy-handed, dull-witted claimant for public handouts, according to the caliber and training of the young men who enter the industry.

Many views have been expressed about the type of education needed for today's mining industry. Criticisms have been aired to the point that further controversy amongst ourselves could be detrimental to both mining education and the mining industry. It is time we get together and start going somewhere.

To canvass the various attitudes of mining educators, a questionnaire was sent to a group of these dedicated, intelligent men, whose primary interest is to help the industry and the profession. The following is a summary of their views.

There was rather general agreement with the view expressed by Mr. Wood in the letter to the editor featured in MINING ENGINEERING (November, 1960) that it is important for the industry to clarify its need for minerals engineers. There is no doubt in the minds of mining educators that the industry is making a serious mistake in not supporting development of competent specialists in the mineral field, and in permitting the former high standing of the mining professions to deteriorate. There is a strong feeling that the industry of the future has much to gain from attaching more dignity and importance to technical proficiency and accomplishment.

In regard to curricula, a large majority is not in favor of more specialized curricula or a separate curriculum aimed at mining industry management. The majority is convinced that present curricula and a 4-year degree are the best basis for proceeding, it being generally recognized that modifications should be made from time to time to meet changing conditions. Many believe that most industrial critics do not realize to what extent changes are constantly being made, and are relating their criticisms to past educational practices.

The majority of educators stress the importance of basic cultural, mathematical and scientific training in the four-year curriculum, believing that specialization should come in the later part or in graduate study. They think that management training, to the extent feasible in school, should be combined with technical training. Most of them would endorse longer education aimed at either specialization or rounding out the 'whole man" if there were sufficient appreciation in industrial circles to make the longer programs attractive to students. The belief is nearly universal that the present picture in the industry makes long educational programs impossible to sell, and that curricula can be readily modified if the industry will clarify its needs and develop an attractive image in the minds of able, ambitious youths. The notion that hard selling can overcome the handicaps of the present industrial image is scouted as ridiculous. Educators are generally aware that the mining business is not attracting its share of the better portion of the youth crop, and are baffled as to what can be done effectively unless the image is improved.

There was some comment that the best way to specialize in either management or technology is by graduate work after some industrial experience. It is suspected that a majority would have endorsed this viewpoint had the question been asked. One of the principal objections to an undergraduate curriculum in management is based on the belief that management capability cannot be determined without experience.

Reaction to industry viewpoints about education is mixed and confused. Educators see no consistency in industry opinion on this subject and think that most industry concepts are not abreast of current educational policy. Industry spokesmen recommend a diversity of subjects for inclusion into curricula that in the aggregate could hardly be packed into six years and at the same time they stress fundamentals. Industry representatives plead for more literacy, for better expression, written and spoken, for more cultural breadth, for foreign languages, for better economic comprehension, for more capability in getting on with people, for better grounding in mathematics, physics and chemistry, and for a variety of skills beyond the basic techniques of mining, milling and smelting, including law, business administration, labor relations, sales management, accounting, finance, industrial engineering, statistics, computer programming, and operations research. Coupled with these suggestions is an industry position that won't compete aggressively in recruiting, that won't pay any premium for longer education, that puts engineers on technician-level jobs for years after graduation, that promotes slowly but lays off readily, that holds technology in low esteem, and has but few really good technical jobs toward which to strive. Industry men tend to blame curricula for lack of student interest, without perceiving that the main deterrent is the poor image which the industry presents in the eyes of ambitious youths. Despite

E. JUST, Member of SME, is Executive Head of the Department of Mineral Engineering, Stanford University, Stanford, Calif.

the good will with which industry suggestions are offered, it seems that educators are justified in being confused and frustrated at industry attitudes.

Regarding the routine through which the industry puts technical graduates, opinions are divided. Some see the labor portion as of no use to technical personnel, others as beneficial to future managers. Several respondents observed that the time for labor experience is in summer employment during undergraduate years, and expressed the wish that industry would be more liberal in accepting summertime employees. There is a general feeling that industry programs could be improved as to value, interest, and supervision, that the labor aspect is overstressed, and that engineering graduates have their initiative curdled and hopes chilled by long years at such unimaginative chores as surveying and sampling.

Most educators believe that good on-the-job training programs are of vital importance, particularly because rapidly changing conditions require the schools to stress fundamentals. Educators are deeply perturbed at general industry indifference toward such programs and at the primitive nature of most of those that exist.

Responses were sought with respect to the type of education usually called work-study, wherein students spend from a fourth to half of their time in industrial employment, switching with alternates so that the industrial job is constantly occupied by one of them. This system had many advantages from all viewpoints. It attracts students, and provides a basis for some to obtain education who could not otherwise afford it. It stimulates interest in studies and brings realism to the classroom. It gets the labor and technician levels of experience over at an appropriate stage and turns out a more finished product. It enables a student to determine his adaptability to the industry at an early age and, if he sticks, to modify his education to suit his particular capabilities. It enables employers to help deserving lads from mining communities, to determine desirable candidates at an early stage, and to shape their educations to mutual advantage. Four mining schools have utilized this method in recent years, and their reaction is enthusiastic, despite the inconvenience.

With respect to general suggestions toward improvement not covered above, educators believe that the mining industry is tragically mistaken in not competing more aggressively for a share of the cream of the college crop.

If industry wants technical "quarterbacks", broadly trained in a number of technical specialties and indoctrinated in mining's special problems so that they can coordinate the diverse technical activities that the industry employs, it is important to encourage this type in some way. Today the young jack-of-all-trades engineers find themselves surrounded in industry with technical specialists more deeply trained along special lines than themselves, and thus more likely to gain recognition in technical departments. The "jacks" would have some advantage in management, but a substantial portion of engineers are not well adapted to management functions. Thus, a large portion becomes lost in the lower midsection of the industry, a disappointment to themselves and to their managerial supervisors. If on the other hand, industry does not care about the jack-of-all-trades engineer—and many industry spokesmen have dismissed him as obsolete—but does want technical men specially trained for the industry, it becomes important to encourage research and development along lines not embraced in other recognized technical specialities, such as rock mechanics, ground support, and the breaking and handling of rocks in ways peculiar to mining. Otherwise where are these specially trained technical specialists to find their place in the industry?

Most mining educators believe that, whether or not undergraduate curricula should be longer than four years, a fifth or sixth year of education would be valuable to the better candidates. It is universally recognized that education cannot make a man, but stoutly maintained that good education can make a man much better. Most educators believe that industry would be wise to encourage its better personnel to return to school to round out their training, improve research capability or develop a specialty. They know that a large majority of those who have taken graduate work, whether after industrial experience or not, have been glad that they did so.

Lastly, most educators believe that the industry would profit by improving earning power during the first ten years of employment and by vivifying promotion policies for the proficient. Also, they feel sure that if industry realized the adverse impact of its readiness to lay off young technical personnel on youngsters making their vocational choices, it would find a way to modify its attitude.

THE NEWTON-WHITING SURVEY

A survey of mining industry management opinion performed by Messrs. Newton and Whiting of the College of Mines, University of Idaho, appears to reflect with reasonable accuracy the views of those who are not only in the mining industry, but in decision-making positions within it. Newton and Whiting report that somewhat less than half the engineers hired by mining companies are mining engineers and that only a small majority of mining employers prefer mining engineers over other engineers. About 40% of mining executives are mining engineers. About two-thirds of the respondents are satisfied with four-year graduates. Only 10% will pay any premium for education beyond this, and the premiums are small. As for opportunities for their young engineers to move upward, the majority are into management, but most employers do not attach particular importance to mining engineering training as a preliminary to managerial status. There is a strong tendency to regard the man as more important than the education. The emphasis on individual energy, versatility and aggressiveness is so strong that the majority is against competing in college recruiting, on the theory that aggressive, capable candidates will do their own job rustling. Mining engineering departments enjoy no special status in industrial organizations, being simply regarded as service groups and among the places where management raw material can be parked. There is a preference for engineering training, but the emphasis is on basic training, i.e. mathematics, "basic engineering" and English. As groundwork for future advancement, presumably in addition to courses in mining and metallurgy, preference was indicated for economics, history, accounting, management, and industrial engineering. Although less than half the respondents advocated special curricula in mining industry management, the above preferences suggest that a majority favors seasoning curricula with subjects pertinent to management. Less than half the responding companies have on-the-job training programs.

This author endorses most of the educator views described above, including the desirability of building up the status of technology and the mineral engineering professions. The emphasis that developing countries place on technology is a clue to its basic importance, and all of us are aware of the immense advantage that communist states are likely to achieve by their special attention to technical development. More emphasis, including support for basic research, would pay off, both industrially and nationally. In this connection, it is interesting that the coal industry, as reported by Newton and Whiting, is more interested in mineral engineers than are the other branches of the mining industry. Not many years ago coal operators made relatively less use of engineers, but the struggle for markets in the face of rising labor costs has taught this group to appreciate technology. Certainly no other branches of mining have a lesser stake in efficiency or that their problems are less technical.

Having a deep conviction that the progress of mankind through the centuries has been mainly due to the special energy, intelligence and leadership of less than 20% of the world population, this author believes any industry which is not getting its share of the best of the youth crop is in trouble. We are not getting our share, and whatever steps will close the gap should be considered vital. We do not believe in developing an aristocracy of education, but cold statistics make it apparent that most of the leaders of the future will be college-trained. Thus, to sit in our shops and offices waiting for stalwart, sterling types to beat their way to our doors simply ignores the competition that exists for the best of the youth crop. Why should they beat their way to our distant and not very receptive doors when numerous others are competing aggressively for their talents? These competitors for talent are not as fearful as we of spoiling the younger generation with attention and promises, but they seem to get results.

Furthermore, it is difficult for this writer to share the view that the "jack-of-all-trades" engineer, whom it is becoming fashionable to deride in both industrial and educational circles, is obsolete except by failure of the industry to make a place for him. Don't we want chief engineers to have technical breadth, and if you agree that the best management training for mining would be a combination of cultural rounding, technology and business training, wouldn't we want the technical part to be diverse rather than specialized? Actually what various industry people call for requires the same jack-of-all-trades exposure to civil, mechanical, electrical and industrial engineering, plus a better cultural rounding, better self expression and a firmer mathematical-scientific base, capped with further technical specialization or management training. The awkwardness of our position is that even at some sacrifice of mining technology, this job cannot be done in less than five years and the industry majority does not encourage the added training. The industry majority is wrong. This does not argue against a four-year degree or an interim of industrial experience. Simply stated, a modern education for mining requires all the facets mentioned above and, no matter how it is sliced, the complete job cannot be done in four years. On-the-job training, utterly desirable as it is, cannot perform these particular functions without organized schooling which the industry is not prepared or likely to undertake.

There are those who argue that the industry, with larger organizations employing many diverse specialists, and a convergence toward fewer methods, in which simple earth-moving plays a large part, does not need jacks-of-all-trades as either quarterbacks or captains. But ask them, "How adequate is a mine operator who knows nothing about geology, as is the case with most civil, mechanical, electrical and industrial engineers, and legal or business graduates?" and "Have they ever had the experience of working under decision makers who do not understand the fundamentals of what they are governing?" The management of the mining industry today will not be improved by being thrust into the hands of people who lack special training for its needs. What we need for key positions are engineers with both breadth and specialized depth, and managers grounded in our technology as well as business training, with more cultural versatility all around. This is a large order, but the future is a large future, and the demands on the mining industry will be greater and greater. The need for competence will be so urgent that better training will have to be provided for those fitted to take command. If the industry fails to recognize this, it will have to send its more promising employees back to school, as many progressive firms in various fields are now doing.

The need of special management training for men in the mining industry seems obvious. The industry is too technical to be managed effectively by people lacking technical grounding, but on the other hand, we are aware that technical training alone is not adequate preparation for management. Simple arithmetical calculation of where the good jobs are in mining compels us to recognize the need for business training. It is absurd to assume that good management is learned simply and naturally through industrial experience, as most business organizations have much to learn about management. To say that management aptitude cannot be gaged in school is tantamount to saying that management qualities are more subtle than scientific or technical qualities. This is hard to believe. Leadership, drive, organizing capability, and the ability to get on with people are fully as likely to be evident in college students as technical ability, although we recognize that in all fields many excellent performers find themselves later in life. For the doubtful cases perhaps a combination of cultural breadth, scientific grounding, technical breadth and business training is a far safer course than commitment to technology alone. This is intensification of the jack-of-all-trades concept which is commonly termed "obsolete," but the man thus trained is less likely to get trapped in the midsection of the industry than the average technical graduate, and has a better basis on which to build specialization, whether technical or managerial.

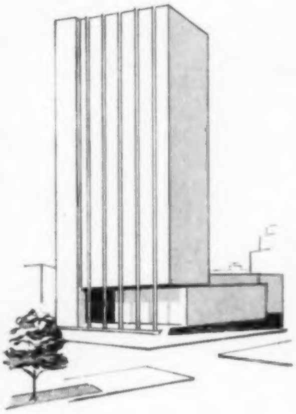
It should be pointed out that about two-thirds of the job of making mining industry education more attractive to youths and satisfying to graduates appears to be the responsibility of the industry. The biggest and most urgent part of this job is to provide a better image in the eyes of young men. Without this, everything else is relatively futile. More interest in technology, better on-the-job training and a willingness to cooperate in work-study programs will be very helpful. The gains or losses will be chiefly to the industry. However, all educators will surely pledge their willingness to cooperate toward a finer future, a greater country, and a better world.

SME BULLETIN BOARD

Reports of Your Technical Society

EAST SIDE

WEST SIDE



SME members attending the Annual Meeting in February will be going "all around the town" from convention headquarters at the Statler-Hilton to the UN Plaza for a look at the new offices of the Institute

(Details on page 1080)

OCTOBER AGENDA

2-3 AIME-CIM Meeting, Ottawa

3-4 Southern Research Institute, Birmingham

5-7 AIME-ASME Joint Solid Fuels Conference, Birmingham

FOR YOUR ATTENTION

Don't Forget Our New Address Is

345 East 47th Street, New York 17, N.Y.

SOCIETY OF MINING ENGINEERS OF AIME

345 East 47 Street • New York 17, N. Y.

OFFICE OF THE SECRETARY

re: Out-of-Print Volumes

Dear SME Members:

Among the many useful volumes published by AIME in the past and now out of print are:

Coal Preparation	D. R. Mitchell (Editor)
Ore Deposits of the Western States	W. Lindgren
Porphyry Coppers (Original Edition)	A. B. Parsons

From time to time we receive orders for each of these. Interest in a new "Coal Preparation" volume has been sufficient to warrant a complete rewrite which is now underway. Publication is tentatively scheduled for 1965.

Interest in "Ore Deposits" and "Porphyry Coppers" has not been so well defined. A second volume on the "Porphyry Coppers" by A. B. Parsons, published in 1957, supplements but does not replace the earlier volume. Lindgren's great book on ore deposits in the West is, of course, a classic.

Prime purpose of this letter is to define the demand for these two volumes. Price will depend on such demand, but it is believed that they can be reproduced and sold for $5.00 each.

Please write me at our new address—345 East 47th Street, New York 17, N. Y.—and tell me whether you will purchase a reprint of "Porphyry Coppers" or of "Ore Deposits". If you are interested but do not have time to write, just fill in your name and address on the Reader Service Card on page 933, **circle No. 149** for the Lindgren volume and **No. 150** for the Parsons volume, then drop it in the mail box.

Notation on the inquiry card will serve only as a measurement of possible demand. It is *not* an order for either volume.

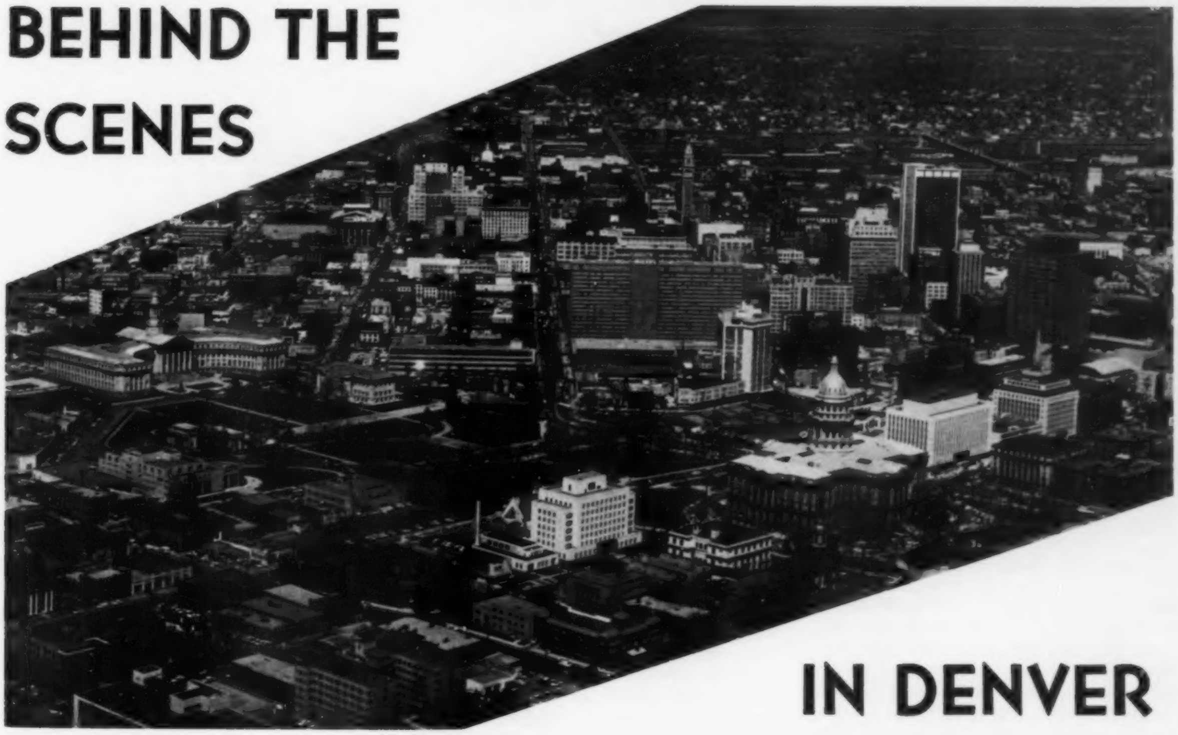
Your cooperation in this matter will be deeply appreciated.

Sincerely,

Jack Fox

John Cameron Fox

BEHIND THE SCENES



IN DENVER

Culminating the planning that first began in 1957 for the Commemoration of the 50th Anniversary of Froth Flotation in the U.S. is the meeting being held in Denver this month, September 17-20. It is the result of the combined efforts of many men who have been working for more than four years to make this occasion a tremendously successful one.

F. E. BRIBER, SR.

General Chairman

50th Anniversary of Froth Flotation in U.S.

NEIL PLUMMER

1961 Chairman Minerals Beneficiation Division of SME

J. D. VINCENT

Chairman Executive Committee

50th Anniversary of Froth Flotation in U.S.

D. W. FURSTENAU

Chairman Editorial Committee

50th Anniversary of Froth Flotation in U.S.

Pictured here are some of the men who have played a leading part in formulating plans and making arrangements for the meeting and for the publication of the commemorative volume.

On the local scene in Denver, the following people served as committee chairmen: W. D. Cramer—arrangements, Hildreth Frost— technical sessions, F. M. McKinley—program organization, T. H. Kuhn—publications and translations, O. W. Walvoord—publicity, E. D. Dickerman—banquet, R. D. Moody—luncheon, E. H. Crabtree—Scotch Breakfast, A. L. Hill—cocktail parties, Clyde Johnson—registration, Pat Ross—trips and Mrs. Fred Smith—ladies program.

The one additional element needed to assure the success of this meeting is *you*. If you haven't made your registration yet, send your advance registration and hotel reservation request via airmail *today* to AIME, P. O. Box 1923, Denver, Colo.

According to present plans the 50th Anniversary Volume should be available early in 1962. Prices are: Members—prepublication $8.00, later $10.00; non-members—prepublication $12.00, later $14.00. The volume is comprised of 23 specially authored chapters as follows: *Early American Ore Dressing Practice* by P. R. Hines, *Sketch of Early Commercial Flotation* by P. R. Hines and J. D. Vincent, *Historical Outline of Major Developments in Flotation* by E. H. Crabtree and J. D. Vincent, *The Magnitude and Significance of Flotation in the Mineral Industry of the U.S.* by C. W. Merrill, *Physical Chemistry of Flotation Systems* by P. L. de Bruyn, *Theory of Nonmetallic Mineral Flotation* by F. F. Aplan and D. W. Fuerstenau, *Theory of Sulfide Mineral Flotation* by J. Rogers, *Froths and Frothing Agents* by R. B. Booth and W. L. Freyberger, *Flotation Kinetics* by N. Arbiter and C. C. Harris, *Applied Flotation Research and Development* by R. J. Brison and R. D. Macdonald, *Standard Flotation Separations* by C. Thom, *Statistical Methods in Flotation Testing and Mill Operation* by W. A. Griffith, *Flotation Circuit Design* by A. Dorenfeld, *Flotation Machines* by N. Arbiter, *Fine Particles in Flotation* by T. P. Meloy, *Preparation of Flotation Plant Feed* by R. R. Smith, E. E. Sougstad and R. D. Carpenter, *Plant Practice in Sulfide Mineral Flotation* by F W. McQuiston, Jr., and E. C. Tveter, *Plant Practice in Nonmetallic Mineral Flotation* by R. E. Baarson, C. L. Ray and R. H. B. Treweek, *Mill Control* by C. G. H. Bushell, J. E. Lawver and W. Barbarowicz, *Analysis of Operating Mills* by F. M. Lewis, T. M. Morris, G. M. Bell and W. C. Lay, *Flotation Economics* by S D. Michaelson and N. Weiss, *Coal Flotation* by D. J. Brown and *Outlook for Flotation* by A. M. Gaudin.

The editorial committee working under D. W. Fuerstenau in the preparation of this volume includes: F. F. Aplan, N. Arbiter, B. H. Clemmons, P. L. de Bruyn, E. W. Engelmann, W. I. Freyberger, F. C. Green, D. W. McGlashan, S. F. Ravitz, E. C. Tveter, N. L. Weiss and S. R. Zimmerly.

"Wonderful Town" at Your Feet

Gateway to the world—the new International Airport at Idlewild welcomes passengers to the U.S. and speeds others on their way to the four corners of the globe.

The AIME Annual Meeting returns to New York for 1962 and something new has been added—the new Engineering Center. SME members attending the 91st Annual Meeting February 18 to 22 will have a chance to visit the Institute's new headquarters facing the U.N. grounds. Meeting headquarters will be at the Statler Hilton Hotel as usual so a trip across town will be in order. It may give you a new perspective on *Our Town* and might even be your first view of the U.N. Make plans now to visit both.

Arrangements are underway for the All-Institute social events and veterans of these meetings will find the mixture is pretty much "as before." The Welcoming Luncheon, Informal Dance, the Annual Banquet and Reception are all on the agenda. There are hints of an innovation for the Dinner-Smoker but plans aren't definite yet.

Programming for the technical sessions is being handled by the Divisions as usual. For preliminary reports on the M & E and IndMD sessions see pages 1085 and 1083 respectively in this issue of MINING ENGINEERING.

SME Education Session

The Education Committee, under the chairmanship of Willard C. Lacy, has planned its session for Sunday afternoon, February 18. The program consists of four papers: *Changing Government Policies and Laws and Their Effect Upon the Mineral Industry* by Charles H. Behre, Jr., *The Place of New Analytical Methods in the Mineral Industry* by W. M. Tuddenham, *Developments in the Field of Rock Mechanics* by J. J. Reed and *Utilization of Operations Research Techniques in the Mining Industry* by E. L. Vickers.

SME Mineral Economics Session

Richard M. Foose, program chairman of SME Mineral Economics Committee, has announced that the Committee is planning on three sessions during the Annual Meeting. Five papers will be presented at Session I on the theme *Mineral Imports and Stabilization Policy;* four papers on the subject *Impact of International Developments in 1960-61* will be given at Session II; and four papers are planned for the final session on *Linear Programming Applied in the Mining Industry.*

Bylaw Changes Proposed

The following proposals for changes in the Bylaws were made at the June 20 meeting of the AIME Board of Directors:

Current AIME Bylaws provide that a Member be carried on the rolls for two years after his dues become due. Relatively few Members pay their dues during their second year of delinquency, yet the cost to the Members in Good Standing to carry these Members a second year is appreciable. It is proposed to revise AIME Bylaw **Article II, Section 4. b,** from "unpaid for two years" to "unpaid for one year" to provide that delinquent Members be dropped one year after their dues become due, effective Dec. 31, 1961.

The AIME Board of Directors voted to change the name of the *Secretary* of AIME to *General Secretary* of AIME. It is proposed to amend the Bylaws to this effect wherever applicable.

Minerals Industry to Meet in San Francisco

Plans for the Pacific Southwest Minerals Industry Conference to be held April 12 to 14 at the Palace Hotel, San Francisco are under way. The conference is sponsored by the San Francisco Section of AIME with the aid of the co-sponsoring Nevada and Southern California sections.

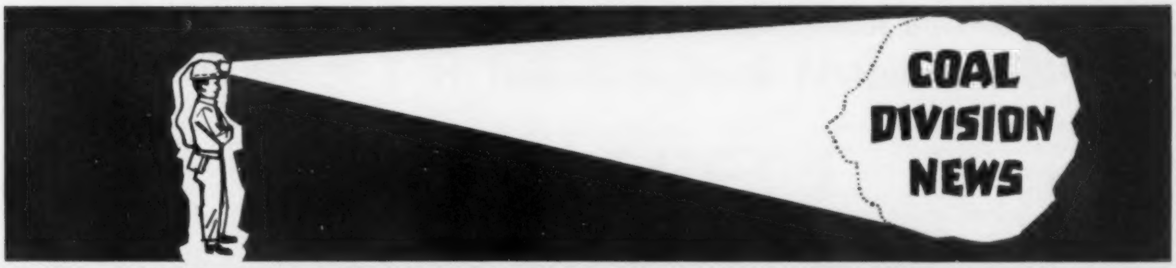
The program committee under the chairmanship of Karl W. Mote consists of J. K. Brooke, R. M. Stewart, W. T. Griswold and J. B. Newsom.

In addition to the technical sessions, a field trip is being worked out for Saturday, April 14.

Fritz Award for 1962 Goes to Greenewalt

Crawford H. Greenewalt, E. I. du-Pont de Nemours & Co. Inc., was unanimously selected as recipient of the John Fritz Medal and Certificate for 1962 by the members of The Medal Board of Award. The presentation will be made by The American Institute of Chemical Engineers, one of the five sponsoring societies. The other societies are the ASCE, AIME, ASME and AIEE. The award, one of the highest honors bestowed by the engineering profession, was established in 1902 to perpetuate the memory of John Fritz's achievements in industrial progress.

The citation to Mr. Greenewalt reads: "For outstanding contributions to the American free enterprise system through leadership in research, in the translation of research achievements by way of sound engineering into useful products and through his able championship of that system both in the spoken and written word."



A panoramic view of Birmingham's skyline against the background hills—locale of the AIME-SME Joint Solid Fuels Conference.

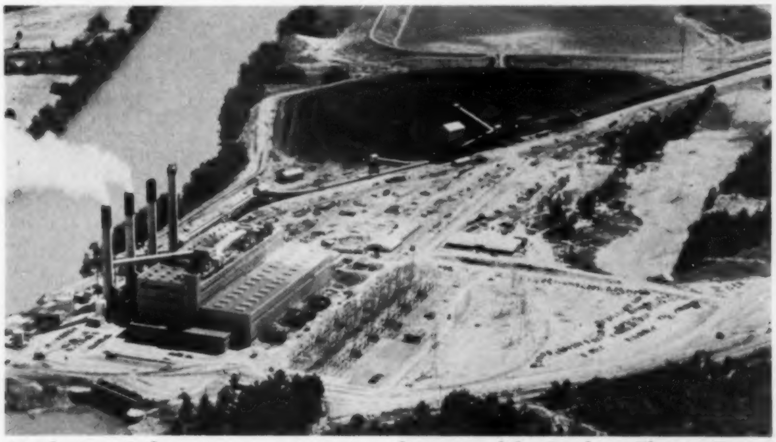
Joint Solid Fuels Conference

Last minute details for the AIME-ASME Joint Solid Fuels Conference to be held in Birmingham, Ala. from October 5-7 have been set. As previously announced, Joseph E. Moody, president of National Coal Policy Conference will be the principal speaker at the banquet Thursday evening, October 5. Brig. General R. M. Hurst, U.S. Army, commander of the Army Ballistic Missile Agency, Redstone Arsenal, Ala. will be the featured speaker at the luncheon on Friday, October 6.

Saturday morning a field trip has been arranged to the Southern Electric Generating Co.'s new steam generating plant under construction at Wilsonville, Ala. At the time of the tour, three of the four 250,000-kw cross-compound turbo-generator units will be in commercial operation and the fourth will be under construction. In addition to the steam plant, the company owns two new coal mines which will supply a major portion of the 2,500,000 tons of coal required annually by the plant when in full operation. With the plant located close to vast Alabama coal reserves and within economical transmission distance of Georgia and Alabama load centers, this is a good example of the *coal by wire* concept. The latest technology in coal burning steam plants has been utilized in the new plant, and mining and mechanical engineers alike should find this trip highly interesting. The ladies are invited to make this trip.

In addition to the field trip, a special program has been arranged to keep the ladies present occupied. Coffee will be served both Thursday and Friday mornings in the Hospitality Room of the Tutwiler Hotel. A luncheon is planned for Monday at The Club, situated high atop Red Mountain overlooking Birmingham. In the afternoon a tour of Southern Research Institute is planned. On Friday afternoon visits to Arlington Confederate Shrine, Oscar Wells Museum of Art and other points of interest have been arranged.

Registration for the Conference begins Wednesday evening, October 4 and continues the next morning. For the technical program see MINING ENGINEERING, August 1961, p. 993. Abstracts of the AIME papers to be presented at the Conference are on p. 1017 of this issue.



Aerial view of the new steam generating plant, owned by Southern Electric Generating Co., at Wilsonville, Ala., which is to be the feature of the field trip on Saturday.

Old Timers Award

GEORGE ANDREW OWENS, JR.

This year's winner of the Old Timers Award for the best senior student in mining engineering at Virginia Polytechnic Institute was George Andrew Owens, Jr., who is employed by the Island Creek Coal Co. and attended the Institute on the co-op program, achieving an outstanding record.

RAYMOND E. DAWSON
Coal Division News Editor

Diamond Jubilee Alumni Reunion Held on Houghton, Michigan Campus

Highlighting the 75th anniversary of the Michigan College of Mining and Technology was the Diamond Jubilee Alumni Reunion, which brought 2000 alumni and members of their families to the Houghton campus August 2 to 5. The three-day program got off to a start at 9 a.m. Wednesday with an Alumni Seminar on the theme: *The 20th Century: Years of Development or Years of the Destruction of Natural and Human Resources?* The seminar resumed after lunch, with discussion continuing until 4:30.

That evening a pre-reunion Dinner was held at the Douglass House sponsored by the MCM Club of Chicago, the oldest Michigan Tech alumni organization.

Thursday was campus open house day, followed by a Welcome Back Dinner at Wadsworth Hall and a theater party at the Keweenaw Playhouse.

The major event of the celebration was the 75th Anniversary Alumni Convocation held Friday morning in Sherman Gymnasium. At that time five distinguished alumni of the college received honorary doctorate degrees and 275 alumni, who have passed the 50 year milestone in their alumni lives, became *Golden M Club* charter members.

This was the first time in the history of the college that honorary degrees were conferred during an alumni reunion. Recipients of the Honorary Doctor of Engineering degrees were: Martin H. Caserio, general manager, Delco Div., General Motors; Robert M. Peterson, retired technical vice president of Rhodesian Selection Trust Ltd.; George B. Robbe, retired after a long career in mining in Utah-Nevada; and H. Carroll Weed, vice president and general manager of Inspiration Consolidated Copper Co.

The Honorary Doctor of Laws degree was conferred on George A. Osborn, publisher of the Sault Ste. Marie *Evening News*, and member of the Mackinac Bridge Authority.

Martin J. Caserio delivered the Convocation address *The Need for Good Leaders*, in which he challenged alumni to accept positions of leadership in supporting their college and in other worthwhile causes.

The bestowing of Honorary Doctor of Engineering degrees during the 75th Anniversary Alumni Convocation at the Michigan College of Mines and Technology. In the picture to the left Robert M. Peterson, center, has his hood adjusted by Lawrence Rakestraw, associate professor of history and political science, left and James Neilson, assistant dean of faculty and professor of geology. Below: H. Carroll Weed receives Dr. Rakestraw's ministration as Walfred Been, head of the mining engineering department, and John R. Van Pelt, president, of the college, look on in approval.

Nuclear Congress Set for New York in 1962

Public aspects in the use of nuclear energy, as well as engineering and operational problems within the industry, will highlight discussions at the technical sessions of the 1962 Nuclear Congress and Atomic Exposition to be held June 4 to 6 in the New York Coliseum. The event, sponsored by the Enginers Joint Council Inc., will be the first of what is planned as a biennial gathering for engineers, scientists and technicians engaged in the nuclear field.

According to J. C. Woodhouse (E. I. du Pont de Nemours & Co.), Program Committee Chairman, the technical program will cover the following major areas: Public Aspects of Nuclear Use, Problems of Advanced Reactors, Nuclear Education for Engineers, Computational Problems in the Nuclear Industry, Application of Atomic Physics for Tests of Materials, Instrumentation, Testing Methods, Radiochemical Separation, Fuel Cycling and Nuclear Safety.

Sessions in these areas will be held concurrently, June 5 and 6. June 4 will be devoted to an all-day General Session at which a number of papers will discuss *Operating Experience with Power Reactors.*

The Congress Manager for the event is Newell Appleton, AIME. The General Chairman is Lombard Squires of E. I. du Pont de Nemours & Co. Inc. The Reber-Friel Co. of Philadelphia will be in charge of the exhibits for the event.

23rd Annual Mining Symposium to be Held in Duluth in January

The 23rd Annual Mining Symposium of the University of Minnesota and the Annual Meeting of the Minnesota Section of AIME will be held in Duluth from January 15 to 17, 1962. The three-day program is sponsored by the School of Mines and Metallurgy and the Center for Continuation Study of the University, in cooperation with the local section of AIME. It is expected that more than 750 leaders of the iron ore mining industry will attend the meeting. Six technical sessions will feature papers covering beneficiation and agglomeration of taconites, magnetic roasting and metallized pellets, blast furnace performance with agglomerates and new developments in the exploration, mining and beneficiation of iron ore. In all, about 20 papers will be presented. Proceedings of the three-day meeting are given all registrants or may be purchased from the Center.

Details regarding the program and registration may be obtained by writing the Director, Center for Continuation Study, University of Minnesota, Minneapolis 14, Minn.

INDUSTRIAL MINERALS NEWSLETTER

Annual Meeting Previews

Ray Kazmann and his hard working committee members are telling of some interesting papers scheduled already for the February 1962 Annual Meeting, (and they are talking about some for 1963 and 1964!) Included among the now scheduled papers are *Beneficiation of Kyanite Ores* by James E. Castle, *Barite Mineral Dressing* by Earl Sockett, *Use of Well Logging in Exploration for Evaporite Deposits* by E. Urash and Don R. Richner, *Salt Deposits and Possible Future Discoveries in the Southeastern States* by William A. Riggs, *Michigan Limestone Industry* by C. Hogberg, *The Cutting of Dimen-Stone—New Developments* by Howard L. Hartman, *New Beryllium Ore Developments* by E. B. Hotchkiss, *Outlook for Mica* by S. A. Montague, *The Rare Earths Picture* by Howard E. Kremers, *Trends in Graphite Use and Supply* by George F. Pettinos, Jr., *Water-Vital Raw Material in the Mining and Processing of Phosphates* by Lawrence A. Roe, *Depletion Allowance for Ground Water* by F. W. Mueller and *Ground Water Studies in the Soviet Union* by Jose DaCosta. There are more pending. An excellent instructive meeting appears in the offing.

Program Policy Committee

The men working with Ray Kazmann on the Program Policy Committee are: **Richard J. Lund,** Battelle Memorial Institute. He was born in Racine, Wis., and graduated from the University of Wisconsin where he majored in geology. From 1934 to 1937 he was in government service, first with the Department of Commerce and then with the Bureau of Mines. In 1937 he became editor of *Mining Congress Journal* and continued there until 1940 when he returned to government service during World War II. He has been associated with Battelle Memorial Institute since 1948.

James C. Bradbury, Illinois State Geological Survey. A native of Illinois, he graduated from the University of Illinois with an A.B. degree in geology. He later completed work for his A.M. and PhD. degrees at Harvard University. He has been with the Illinois State Geological Survey, Industrial Minerals Section since 1949.

Paul M. Hedley, Udel Realty Corp. Mr. Hedley was born in Port Arthur, Ont., and spent his childhood in British Columbia, New York and Ontario. He is a graduate of the University of Toronto. Following short stints at mining, prospecting and work at a smelter, he joined Ventures Ltd. remaining with the firm until joining the Canadian Army during World War II. After the war he operated a gypsum plant in Nova Scotia. In 1949 he moved to the U.S. to work for North American Cement Corp., an association which lasted until this year when he became president of Udel Realty Corp., a subsidiary of N. Y. Trap Rock Corp.

M. J. Messel, American Smelting & Refining Co. He is a Canadian and attended both the University of Manitoba and McGill University, graduating from the latter. The early years of his career were spent in Venezuela. In 1946 he settled in Vermont, where he was employed by Vermont Asbestos-Ruberoid Co. In 1957 he returned to Canada to become general manager, Lake Asbestos of Quebec Ltd., at Black Lake. He is presently vice president and general manager.

Oscar Wicken, Harbison-Walker Refractories Co. A native of Spokane and a graduate of the University of Washington, Mr. Wicken went on to take his M.S. degree at the University of Idaho. Before coming to Harbison-Walker, he had worked for Northwest Magnesite Co., the Sunbright Div. of Foote Mineral Co. and Bonneville Ltd., Salt Lake City.

SME-CIM Ottawa Meeting

This is it—the last call for the joint meeting of the Industrial Minerals Divisions of SME and CIM to be held October 1 to 3 in Ottawa. If you haven't made your reservations at the Chateau Laurier Hotel as yet, you'd better hurry, space is going quickly.

Technical sessions will fill much of Monday morning and afternoon and Tuesday morning. See page 988 of the August issue of MINING ENGINEERING for details.

On the social side, luncheons are scheduled for Monday and Tuesday and a dinner is planned for Monday evening. There will be some time on Sunday and Tuesday afternoons to visit the Parliament buildings and a number of other attractions including some of the Mines Branch laboratories in the area.

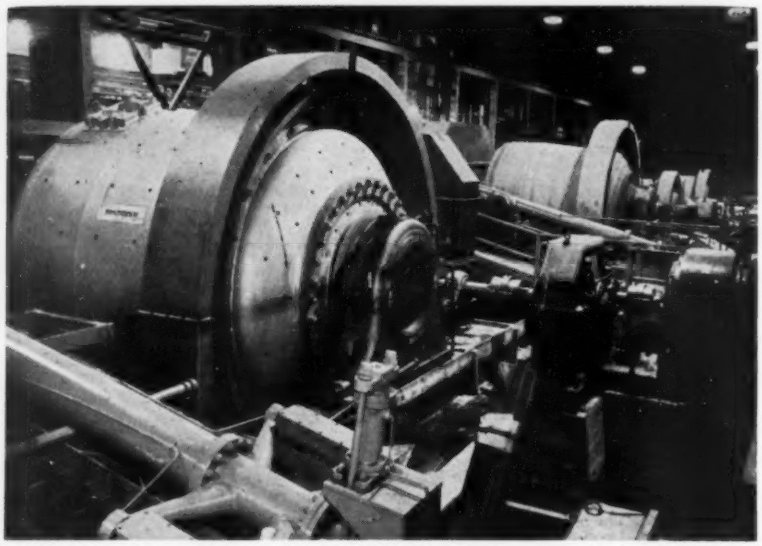
Post-meeting field tours are available, covering a wide area. Check your map (see August issue page 988) and decide what combination would be best for you. A group of visits might coincide with your route home.

Don't forget the ladies. We haven't. A special program is being arranged for their entertainment.

Plan to arrive early and get your registration and field-tour planning done on Sunday afternoon October 1.

(Continued on page 1084)

Chateau Laurier Hotel, Ottawa, Canada, headquarters for Joint SME-CIM Meeting.



11-3-6-10 Hardinge Tricone Mills in the Grinding Department of Opemiska Copper Mines, Ltd. Two Hardinge 8' x 72" Conical Mills can be seen in the Background.

Ind MD Newsletter

(Continued from page 1083)

The registration desk and tour headquarters will open at 1 p.m.

Executive Committee Announcement

The Executive Committee of the Industrial Minerals Division will meet on Sunday afternoon October 1 in Ottawa. The place: Salon F in the Chateau Laurier. The time: 2 pm. All members of the Division are invited to attend.

Highlights of Executive Committee Meeting of June 5, 1961

The finances of the Division being in excellent health, the Division's Executive Committee unanimously voted to contribute $1000 from its reserves to the United Engineering Center Building Fund. The action was taken at a meeting of the Committee in New York, June 5. A letter of appreciation has been received from Joe Gillson.

An *ad hoc* committee presented *a clean copy* of the Division's Bylaws with all amendments oriented. In due time, arrangements will be completed to make copies available through the New York office.

Another *ad hoc* committee is compiling a manual on the *Duties of Officers*. It too will be made available when completed.

Future meeting plans were discussed at length, including the Ottawa meeting in October; the Annual Meeting in New York in February 1962; the SME meeting in Gatlinburg, Tenn., in October 1962; and a possible regional meeting in Seattle, Wash., in April 1962. [The Program Policy Committee is indeed a busy one. It begins to look like it's going to need some *ad hoc* subcommittees!] The Executive Committee adopted as permanent, except for one change, the tentative rules for the Program Policy Committee as set forth at the Executive Committee meeting of Feb. 16, 1960. The change involved selection of Chairman and Vice Chairman. The new ruling states: "The Chairman-elect of the Division shall designate two members of the Program Policy Committee to serve as Chairman and Vice Chairman."

Machinery was set in motion to clarify the status of the Division's Vice Chairmen. There appears to be no record of the specific regional boundaries over which each is expected to have jurisdiction. Also under study is the desirability of having a National Vice Chairman in addition to the Regional Vice Chairmen. Chairman Clausen appointed Vice Chairman Pettinos to head an *ad hoc* committee that will work out the answers. Committee members are all other Regional Vice Chairmen.

ROCK IN THE BOX

Mining & Exploration Division

Forthcoming Meetings

Fall is almost here and it is time to think of meetings. Of course, the American Mining Congress Convention in Seattle is sure to be a success. Probably, as you read this, it will be just winding up, but we have enough faith in Julian Conover and his staff to assume the best.

Another meeting has come to our attention—International Mining Days, a joint venture by the New Mexico Mining Assn. and the Mining Committee of the El Paso Chamber of Commerce. This year it will be sponsored by the El Paso Chamber of Commerce and held in El Paso, October 15 to 18, with the Hilton Hotel as headquarters. The New Mexico Mining Assn. will include its annual meeting as part of the program. In addition, there will be a day-long *Operation Understanding* tour of Fort Bliss, the Army's Air Defense Center. The tour will include observation of actual Nike Hercules missile firings. The get-together this year should be an interesting one.

AIME Annual Meeting

Our own Annual Meeting in New York will soon be upon us. Remember the AIME 1962 Annual Meeting February 18 through February 22, and set aside some time. The program unit committee men, along with Roger H. McConnel, Vice Chairman for Program, have sent us some interesting previews of the sessions. Naturally, as we write this, the entire program has not been fixed, but we can give you some idea of what to expect.

Geological Engineering

Shirley A. Lynch, chairman, and James M. Neilson, program chairman of our newest unit, appear to have put together a fine first program. Cochairmen of the half-day session will be James M. Neilson and Mathew Nackowski. No specific theme has been chosen for the session, but three papers will include studies pertaining to bed rock, structure determination and mapping. Other papers on underground military installations and the 23.3-mile pressure tunnel in Summit and Park Counties, Colo., as well as a tentative paper on water supply and exploration in the King Mountain area are planned.

Underground Mining

Richard M. Stewart, chairman, with Joseph B. Elizondo, program chairman, put together a tentative program of six papers covering a wide variety of underground mining subjects. Mechanization, the use of ammonium nitrate-fuel oil for underground blasting and mining methods and ground subsidence are all topics for discussion. C. S. Boland and H. G. Young of Boland Development Co. Ltd., Canada are preparing a paper entitled *The Sinking of a Circular Shaft at White Pine, Mich.* L. W. Casteel, St Joseph Lead Co., will discuss *The Underground Use of AN-FO Explosives at St. Joseph Lead Co. Operations* and Robert L. Haffner, The Eagle-Picher Co., will tell about rubber-tired and loader application at his company's Illinois-Wisconsin operations. *Some Application of the Undercut-and-Fill Mining Method* is the subject of a paper by J. A. Pigott and R. J. Hall of The International Nickel Co. of Canada Ltd. Two staff members of USBM's Denver Mining Research Center are preparing a paper, *Investigations of the Influence of Block Caving Upon Adjacent Mine Openings.*

Open Pit Mining

Unit Committee Chairman Henry J. Schwellenback and Martin Hanniban, program chairman, are working on a program for one session that will include a progress report on incline drilling, a paper on open pit haulage and a panel session on air blast effects from blasting. These are topics that are of much interest, we know, to those of us involved in open pit work. The committee is therefore going to a great deal of effort to get thorough coverage on the subjects.

Geology

Herbert C. Harper, chairman, Roland Mulchay, program chairman of SME and Harold James, program chairman of the Society of Economic Geologists, have planned a joint SME-SEG session which will be a symposium on epigenetic and syngenetic ore deposits. At this writing no co-chairmen for the session have been designated, but speakers will be T. S. Lovering of USGS, J. J. Brummer of Kennecott Copper Corp. and Charles Meyer of the University of California. Probably two or more additional people will present brief prepared comments.

To quote Roger McConnel's note on the subject—"This being quite a controversial subject, there may well be considerable interest in this discussion by these top men in the field."

Geochemistry

As with the geology session, this will be a joint session with the Society of Economic Geologists. The Mining and Exploration committee chairman D. R. Cook with R. J. P. Lyon, M & E program chairman and Harold James, SEG program chairman, are organizing a session on the theme, *Major and Minor Elements in the Host Rocks of Ore Bodies.* Cochairmen for the session will be R. J. P. Lyons of the Stanford Research Unit and Harold Bloom of the Colorado School of Mines. Five papers are on the program covering varied phases of this subject. They include *Na-K Distribution in Volcanos of N. W. Nevada* by D. Tatlock and R. Wallace; *Distribution of Major and Minor Elements During Metamorphism and Ore Formation* by A. E. J. Engel; *Composition of Sandstone Host Rocks of Uranium Ores* by A. T. Miesch; *CaMg Ratios in Carbonate Host Rocks* by M. A. Klugman and *Some Compositional Effects of Hydrothermal Alteration* by C. Wayne Burnham.

This, then, is a rundown on the tentative February M & E Division Program. As you can see, the unit committees are going to much effort to make an interesting and worthwhile session in New York this year.

Peele Award Fund

As we go to press, there is $200 in the "Fund for Peele" which your Division has set up to reestablish the Robert Peele Memorial Award. The goal is $10,000. Your contribution will be welcome. Please send your check for $1.00 or more to "Fund for Peele" Committee, c/o Society of Mining Engineers of AIME, 345 East 47th St., New York 17, N.Y.

M&E DIVISION NEWS EDITOR

Peter B. Nalle

Riverside Cement Co.
Box 832
Riverside, California

Education News

University of Arizona

The nation's first formal educational program in scientific hydrology—the science of water—will be offered by The University of Arizona beginning with the fall term. The new program of study and research will lead to the B.S., M.S. and Ph.D. degrees in Scientific Hydrology. The program will be administered by a faculty committee under the chairmanship of John W. Harshbarger, head of the geology department.

Southwest Potash Corp.

Southwest Potash Corp. has presented ten *Horizons of Science* films to the Carlsbad, N.M., school system. Produced with the assistance of initial grants from the National Science Foundation, the films are designed as a link between scientists and students to stir the imagination and to stimulate thinking. The films in the series are: *Visual Perception, The Worlds of Dr. Vishniac, Exploring the Edge of Space, Thinking Machines, The Mathematician and the River, New Lives for Old, Project Mohole, The Real of the Galaxies, The Flow of Life* and *Neutrons and the Heart of the Matter*. The company hopes to boost science understanding through the gift of these films.

Colorado School of Mines

The School reports that it graduated 38 men in 1961 with the degree Engineer of Mines. Of these, six went into the U.S. Army, 25 took jobs at an average salary of about $540 per month, and seven, who did not complete their work at the School until the end of summer, had not completed job arrangements at the time of writing.

Scholarships

National Science Foundation

The National Science Foundation plans to award approximately 125 Senior Postdoctoral fellowships to individuals planning additional study and/or research with a view to increasing their competence in their specialized fields of science or broadening their competence in related fields of science. Among the fields in which the fellowships will be awarded are mathematics, physics and engineering. The awards will be made December 11 and the closing date for receipt of applications is October 9.

For complete details and application materials write to: Fellowships Section, Div. of Scientific Personnel and Education, National Science Foundation, Washington 25, D.C.

Peabody Coal Co.

Peabody Coal Co. will participate in a cooperative training program enabling deserving sons of Peabody employes to attend the School of Mines and Metallurgy of the University of Missouri. Under the plan students will get practical working experience in Peabody's mine as well as formal training at the university. The company hopes to select two students to begin training under the program this fall.

Chino Mines

Scholarships valued at $5500 have been awarded to 11 students in New Mexico and in El Paso, Texas, by the Chino Mines Div. of Kennecott Copper Corp. The scholarships of $500 each were awarded to students who have completed at least one year of college and apply to applicants majoring in a wide variety of fields. The colleges involved are: New Mexico Western College, University of New Mexico, New Mexico State University, New Mexico Highlands University, Eastern New Mexico University and Texas Western College. This is the seventh year of the Division's scholarship program.

Princess Coals

Four four-year scholarships have been awarded to outstanding graduating seniors in Floyd and Johnson Counties, Ky., high schools by the Princess Elkhorn Div. of Princess Coals Inc. The scholarships cover study of mining engineering, mathematics and languages. Seventy-five such grants have been made since Princess Coals began its scholarship program 16 years ago.

The Anaconda Co.

Roberto J. Laporte of Cananea, Mexico, has received a $1500 Anaconda Co. scholarship to the University of Arizona. Three other students have had their scholarships, also valued at $1500, renewed. The Anaconda Co. gives scholarships to freshmen planning to study mining or engineering and the scholarships are renewable over a four-year period if the holder shows satisfactory scholastic progress. One recipient is from Arizona and is chosen by the University's scholarship committee. Other recipients—two from Cananea and one from Chile—are recommended to the committee by Anaconda Co. representatives in the two areas.

• The **Pennsylvania-Anthracite Section** held its summer and annual meeting at the Valley Country Club in Hazleton. Nearly 150 people participated in the election of officers for 1961-1962 and heard a talk by AIME President R. R. McNaughton. The other guests of honor were Ernest Kirkendall and his wife.

The new officers are: Paul Goddard, chairman; Ivor L. Williams, vice chairman and Francis X. Farrell, secretary-treasurer. Elected to the Executive Committee for a three-year term were: Charles S. Kuebler, John T. Griffiths, F. Edgar Kudlich, Garfield Schnee and Joseph R. Pagnotti. Alfred F. Stortz was elected to a one-year term.

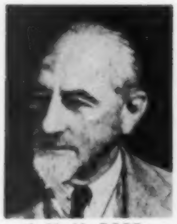
• The July meeting of the **Adirondack Section** was both business and social. It was held at the Tupper Lake Country Club, Saturday, July 29, with registration beginning at 12:30 pm. A special program for members' wives and friends had been arranged by a committee of four of the members' wives. It included golf, bridge, a chair lift ride and a boat ride. Lauren Choate arranged a golf tournament for the men. Also on the schedule was a trip to the Adirondack Museum at Blue Mountain Lake. Music was available for dancing both before and after dinner. After the meeting, horse lovers in the crowd visited the horse show at Tupper Lake.

• **Midwestern Coal Subsection** (St. Louis and Chicago Sections) met August 17 at the Benton Country Club. Golfers arrived at one o'clock to get in a full round before convivialities began at six o'clock. Following dinner, Winfield H. Eldridge, associate professor of civil engineering at the University of Illinois, discussed the applications of photogrammetry to mining. Slides were shown to better explain photogrammetric techniques.

• The WAAIME's of the **Ajo Subsection** (Arizona Section) sponsored a social at the Ajo Country Club on July 19. The occasion was a covered dish dinner and dance.

• The **Mexico Section** held its monthly meeting at the University Club in Mexico City on July 10. About 50 people attended the session presided over by vice president Luis Villaseñor in the absence of the president. Following dinner, Villaseñor who is assistant managing director of The Fresnillo Co. told about the company's activities in Mexico, touching on the historical aspects as well as presenting statistics on current production. At the conclusion of the talk he showed a film dealing with the Fresnillo, Naica and Zimapan units.

Personals


J. V. N. DORR


J. L. MERRILL

The resignation of **John V. N. Dorr** from the board of directors of Dorr-Oilver Inc. was accepted "with great reluctance" and after expressing its regret, the board elected him *Director Emeritus*. Dr. Dorr was the founder of The Dorr Co. one of the two principal predecessors of Dorr-Oliver Inc. Now 89, he is still active in the affairs of The Dorr Foundation and Dorr Associates Inc. He is at present on a three-month tour of Europe and the Middle East undertaken after his resignation.

John L. Merrill, president of The Merrill Co., a San Francisco investment firm, was recently elected to the board of directors of Mandrel Industries Inc. Among his many affiliations, he is a director of The Bunker Hill Co. and a consultant to Arthur D. Little Inc.

James D. Reilly has been elected president of the Hanna Coal Div. of Consolidation Coal Co. Prior to his


J. D. RILEY


S. D. MICHAELSON

election he was vice president—operations.

The degree of Engineer of Mines was presented to **Stanley D. Michaelson,** chief engineer of the Western Mining Div. of Kennecott Copper Corp. at the 61st commencement of the Montana School of Mines.

According to a recent announcement from the Copper Range Co., **Chester O. Ensign, Jr.** has been appointed chief geologist. Since 1955, Mr. Ensign has been in charge of exploration projects for American Metal Climax Inc.

At the annual meeting of the Board of Directors of the American Zinc Institute, the following officers were elected: **F. R. Jeffrey,** National Zinc Co., president; **J. J. Lennon,** American Metal Climax Inc., vice president; **C. E. Schwab,** The Bunker Hill Co., vice president; and **H. L. Young,** American Zinc Sales Co., vice president. **G. H. LeFevre,** U.S. Smelting Refining & Mining Co., was reelected as treasurer and **J. L. Kimberley** was reelected executive vice president and secretary.

Two executive appointments in Hercules Powder Co.'s Explosives Dept. have been announced. **Henry V. Chase, Jr.** has been appointed director of operations for the commercial explosives division, and **Albert R. Ely** assumed the post of manager of industrial relations. Mr. Chase, who has been the department's manager of explosives operations since 1957, came to Hercules in 1940 shortly after graduating from Dartmouth College. Mr. Ely has been with the company since 1914 and had been assistant to the department's director of operations.

Gustav S. Preller, formerly research officer for Cullinan Refractories Ltd. in the Transvaal, has become affiliated with Palabora Mining Co., Transvaal, South Africa.

E. W. Douglass, director of research for Potash Co. of America, has undertaken a one-year assignment in Jordan for the U. N. He will serve as advisor to the Arab Potash Co. in construction of a potash refinery near Amman. The project is for production of potash from brine of the Dead Sea.

The Pennsylvania State University announced recently that **Charles W. Berry,** presently mine taxation engineer with the Minnesota Tax Commission, will join the staff of the Department of Mining in September. He has accepted the position of research assistant in charge of developing the program of operations research for the mining industry now being undertaken at Penn State.

After 15 years with Calumet & Hecla Inc., where he was director of mining, **Colin A. Campbell** has become manager—minerals operations for International Minerals & Chemical Corp.

Ben Parker, Jr., has left the academic field after eight years as an instructor at Colorado School of Mines to become staff geologist, international operations, for American Radiator & Standard Sanitary Corp. He is currently engaged in studies of ceramic

raw materials abroad and is at present in Brazil.

According to a recent announcement of Secretary of Commerce Luther H. Hodges, **Raymond E. Salvati,** chairman of Island Creek Coal Co. and a National Coal Assn. director, has been appointed a public advisor to the U.S. delegation at the 1961 GATT tariff negotiations in Geneva. He is one of 12 advisors representing U.S. business, agriculture, industry and the public.

Conrad A. Wenner, formerly stope engineer with Phelps-Dodge Corp., has taken the job of mining foreman at the Achan mine of International Minerals & Chemical Corp.

J. David Lowell has recently been transferred from Utah Construction & Mining Co.'s San Francisco office to open a Mineral Development and Geology district office in Tucson, Ariz., for Utah Development Co., a subsidiary of Utah Construction & Mining Co.

David Hamon, a student at the University of Alaska, spent the summer working as a geological assistant for the Columbia Iron Mining Co. with the raw materials exploration division in the Beluga Lake area via helicopter. The area is well-known as a coal district.

Following completion of his studies at the Mackay School of Mines, **Jim Cress** has become an assistant mining engineer for American Metal Climax Inc.

Neil L. Anderson has become an engineer for his own firm, Neil L. Anderson, Engineers & Contractors, after serving as engineer with the Al Johnson Construction Co.

The following officers were elected at the National Coal Assn.'s annual meeting: **George E. Enos,** president of The Enos Coal Mining Co., succeeds **Herbert E. Jones, Sr.,** as chairman of the board of directors; **H. Vernon Fritchman,** executive vice president of Rochester & Pittsburgh Coal Co., succeeds Mr. Enos as vice chairman. **Stephen F. Dunn** continues as the Association's full-time president and through a change in the bylaws **Thomas Howarth** was elected secretary-treasurer.

Following graduation from the Mackay School of Mines, **R. C. Brittian** has taken a job with the Insulation Div. of Eagle-Picher Co. He is a process engineer.

Charles Will Wright attended the 75th Anniversary celebration of the Michigan College of Mines and Technology (see page 1080) from which he'd graduated in 1902, and later was given an honorary degree of Doctor of Engineering. His father, Charles E. Wright, state geologist, was one of the founders of the college.

W. H. CROW

M. J. KENNARD

Diamond Iron Works, Chicago has announced the appointment of **Wallis H. Crow** as district sales manager of its western territory. Before his recent affiliation, Mr. Crow was with the Hewitt-Robbins field sales organization.

Max J. Kennard has been appointed business development engineer by Parsons-Jurden Corp., New York mining, metallurgical and industrial engineering subsidiary of The Ralph M. Parsons Co., Los Angeles engineers-constructors. Kennard was formerly a vice president of Southwestern Engineering Co. and Combined Metals Reduction Co.

Chester M. F. Peters has become design specialist—mining for Holmes & Narver Inc. He had been engaged in consulting work for the past five years.

Jack E. Nelson, formerly plant chief for The Jersey Zinc Co., Treadway, Tenn., has gone to Mexican Hat, Utah, to be plant superintendent for Texas-Zinc Mineral Corp. milling uranium. He replaces **K. C. Apland,** who has been transferred to The New Jersey Zinc Co. plant at Palmerton, Pa.

Kaiser Refractories Div. of Kaiser Aluminum & Chemical Corp. recently announced the appointment of **Joseph F. Knight** as vice president of operations. He has been serving as manager of operations for the Division since January 1955.

Sherritt Gordon Mines Ltd. announced recently that a new marketing division, headed by **Alan E. Gallie,** has been formed to better serve the requirements of its customers in North America. The division will be located at the company's head office in Toronto. Mr. Gallie had been assistant to the president.

T. O. Evans recently retired as chief mining engineer for the Santa Fe Ry. He was one of the pioneers in the uranium industry in Grants, N. M., and has been in charge of the Haystack Mountain Development Co. since it first started mining uranium.

Gunther Badorrek, formerly a junior industrial engineer with Crucible Steel Co., has become production engineer in the Compass Div. of Clinchfield Coal Co.

Horace Y. Bassett, Calumet & Hecla Inc., has accepted the chairmanship

H. Y. BASSETT

C. M. ROMANOWITZ

of the Metals and Metal Products Div. of the National Fund for Medical Education for this year's appeal.

Charles M. Romanowitz has opened a consulting office at 2034 Santa Clara Ave., Alameda, Calif., where he is available for consultations in dredge application and operation, both bucket-line and hydraulic. He has had 50 years of experience in the field, nearly 40 of them with Yuba Mfg. Co. For the last three and one-half years he has been with the Ellicott Machine Corp. and continues to be retained by them as consulting engineer.

James S. Kennedy has been transferred from Latrobe, Pa., to St. Louis by American Cyanamid Co. Formerly field representative for the mining chemical department, he has been appointed district metallurgist for the Midwest.

A. K. McClellan, Jr., formerly chief engineer, Adirondack Ore Mines, Republic Steel Corp., has been transferred to the company's general office in Cleveland to become mechanical engineer, Northern Ore Mines. His first assignment took him to the Liberia Mining Co. in Bomi Hills, Libera, West Africa, where he was concerned with problems in the iron ore concentration mill.

Ewald Kipp, mining engineer and special representative for Eimco Corp. has been elected an active member of the Public Relations Society of America.

The 1961 Bituminous Coal Research Annual Award for outstanding leadership on behalf of industry-sponsored coal research went to **Joseph Pursglove, Jr.,** vice president of Consolidation Coal Co. As vice president of research and development of Consolidation since 1947, Mr. Pursglove is responsible for the largest research program ever undertaken by a single coal company. It involves research into economical methods of converting coal into chemicals, special carbons, gaseous and liquid fuels and the pipelining of coals to market.

William S. Hutchings has resigned from New Jersey Zinc Co. to take a position with Atlantic Cement Co. Inc. heading up the purchasing department.

Geddes M. Webster has moved from Minneapolis, where he was a securi-

SME PREPRINTS AVAILABLE — 1961 Annual Meeting, St. Louis

The following list of papers (from the 1961 St. Louis Annual Meeting) will be available until January 1962. Coupons (blue) received with the 1961 Dues Bills and those distributed at the Annual Meeting will be honored until Dec. 31, 1961. Purchased coupon books (yellow) will be honored at any time. As more preprints become available they will be added to this list and bulleted (•).

Preprints may be obtained (upon presentation of properly filled out coupons) **from Preprints, SME Headquarters, 345 E. 47 St., New York 17, N. Y.** Additional coupon books can be obtained from SME for $5 (book of ten) to members or $10 (book of ten) to nonmembers. Each coupon entitles purchaser to one paper. **Please do not use coupons for papers other than those listed by number.**

COAL (F)

Bowman, E. V., and Hurst, E. J.: *Material Handling Aspects of Fine Coal Cleaning*, 61F68.
Boyle, J. A., and Conn, O. S.: *Control of Mine Ventilation Utilizing Multiple Main Fans*, 61F49.
Elliott, M. A.: *Coal Gasification for Production of Synthesis and Pipeline Gas*. 61F61.
Hamilton, G. M.: *Gasification of Solid Fuels in the Wellmann-Galusha Gas Producer*, 61F8.
Hightower, T. R., and Mellor, M. W.: *Thunderbird Collieries*, 61F64.
Jamison, R. H., Jr.: *Full Dimension Systems*, 61F36.
MacDonald, J. W.: *Coal Preparation Plant Facilities, Old Ben Mine No. 21, Sesser, Franklin County, Illinois*, 61F69.
Macpherson, H.: *Froth Flotation in Durham Division of National Coal Board*, 61F42.
Miller, J. W.: *Economic Justification for Froth Flotation*, 61F66.
Mongan, C. E., Jr., and Miller, T. C.: *Use of Sonic Techniques in Exploring Coal-Mine Roof Strata*, 61F33.
Oppelt, W. H., and Kube, W. R.: *Bench-Scale Experiments on Low-Temperature Carbonization of Lignite and Subbituminous Coal at Elevated Temperatures*, 61F1.
Oppelt, W. H., and Gronhovd, G. H.: *Design and Preliminary Operation of a Slagging Fixed-Bed Pressure Gasification Pilot Plant*, 61F18.
Orlandi, W. J.: *Requirements and Advantages of An All-Belt Mine Haulage System*, 61F9.
Parisi, C. W.: *Use of High Expansion Foam on an Actual Mine Fire*, 61F70.
• Peters, J. T., and Shapiro, N.: *Know Your Coal*, 61F62.
Risser, H. E.: *Adaptability of Illinois Coal for Use in Iron and Steel Production*, 61F30.
Sallmann, K.: *German Coal Flotation—1960*, 61F80.
Valeri, M.: *Continuous Mining in the Pittsburgh Seam*, 61F46.
Washburn, H. L., and McConnell, W. A.: *Design of Loveridge Plant*, 61F58.
Weimer, W. A.: *Peabody Coal Company's "River King Mine,"* 61F59.
• Wotring, R. W.: *Lee-Norse Miner in the No. 4 Pocahontas Seam*, 61F63.
Wright, F. D.: *Maximizing the Profit of a Coal Preparation Plant by Linear Programming*, 61F16.

ECONOMICS (K)

Douglas, T. B.: *Economics of 5½ Mile Transport Conveyor Belt at Ideal Cement Company's Ada, Oklahoma, Plant*, 61HK28.
Dubnie, A.: *Transportation of Minerals in Northern Canada*, 61K11.
Eisemann, E. F., Jr.: *Some Aspects of Competition Between Fuels in the United States*, 61K89.
Gritzuk, N.: *Long Haul Transportation of Minerals in Canada's Far North West*, 61HK34.
Jaworek, W. G., and Schanz, J. J., Jr.: *Fuel Interchangeability—Measuring Its Extent in U.S. Energy Markets*, 61K43.
Lasky, S. G.: *Mineral Self-Sufficiency*, 61K4.
Lentz, O. H.: *The Depletion Rationale and Recent Political Pressures of Erosion*, 61K91.
Quinn, F. J.: *Natural Gas and the Competitive Fuel Market*, 61K90.
Riggs, W. A.: *Transportation Economics of Mineral Commodities*, 61HK19.
Robinson, M. E., and Kurtz, W. L.: *Competitive Markets—The Fossil Fuels*, 61K23.
Roetzer, A. A.: *Materials Handling, Transportation, and What Lies Ahead in Packaging in the Cement Industry*. 61HK50.
• Wilhelmy, O., Jr.: *Water Transportation of Fertilizer Raw Materials*, 61HK75.
• Young, R. A.: *The Quota System in Mining—Particularly Lead and Zinc*, 61K96.

EDUCATION (J)

• Forrester, J. D.: *The Future for Educational Training of Mineral Industry Engineers*, 61J98.
• Just, E.: *Preparing Men for Mining's Future*, 61J97.
• Knoerr, A. W.: *What the Mining Industry Expects of Mining and Mineral Processing Engineers*, 61J103.
• Reed, J. J.: *The Interdependence of Mining Education, Research, and the Industry*, 61J99.

GEOLOGY (I)

Baker, A., III, and Scott, B. C.: *Geology at the Pitch Mine*, 61I53.
• Blais, R. A., and Stubbins, J. B.: *The Role of Mining Geology in the Exploitation of the Iron Deposits of the Knob Lake Range, Canada*, 61I101.
Freeze, A. C.: *Use of Punch Card Accounting Machines in Calculating Reserves at Sullivan Mine*, 61I85.
Perry, V. D.: *The Significance of Mineralized Breccia Pipes*, (Jackling Lecture) 61I78.
Shea, E. P.: *The Use of Geology in Butte*, 61I29.

GEOPHYSICS (L)

Fahnestock, C. R.: *Use of Seismic Techniques in Analyzing Subsurface Materials*, 61L45.
Heyburn, M.: *Geologic Mapping with the Aid of Magnetics, Tahawus Area, New York*, 61L13.
Misech, A. F., and Riley, L. B.: *Basic Statistical Measures Used in Geochemical Investigations of Colorado Plateau Uranium Deposits*, 61L37.
Whitten, E. H. T.: *Quantitative Distribution of Major and Trace Components in Rock Masses*, 61L17.

INDUSTRIAL MINERALS (H)

Barnes, R.: *Perlite—A Review*, 61H83.
• Barr, H. W., Jr.: *Problems in Gaging Markets for Specialty Fillers*, 61H100.
Blair, L. R.: *Synthesis of Inorganic Silicate Fillers and Filter Aids*, 61H76.
• Bleimeister, W. C.: *Rock Salt Mining and Economics in the North Central Area*, 61H92.
Czel, L. J., and O'Brien, W. F.: *Lithium Horizons*, 61H60.
• Dole, H. M.: *Mining vs Public Land Withdrawals*, 61H55.
Douglas, T. B.: *Economics of 5½ Mile Transport Conveyor Belt at Ideal Cement Company's Ada, Oklahoma, Plant*, 61HK28.
Goldman, H. B.: *Urbanization and the Mineral Industry*, 61H24.
Gray, J. E.: *Specifications for Mineral Aggregates*, 61H82.
• Golson, C. E., and Newton, D. E.: *Application of Metallurgical Principles, Processes, and Equipment to the Production of Mineral Aggregates*, 61H87.
Gritzuk, N.: *Long Haul Transportation of Minerals in Canada's Far North West*, 61HK34.
Herfindahl, O. C.: *Conflicts Between Mining and Other Economic Activities—A General View*, 61H74.
Jackson, T. M., and Jones, R. K.: *The Role of Organic and Inorganic Fibers in Gaseous and Liquid Filtration*, 61H79.
Kienitz, L.: *Better Aggregate Processing Pays Off*, 61H44.
Landes, K. K.: *Chemical and Metallurgical Limestone in North Central, Northeastern States, and Ontario*, 61H41.
• Lemish, J.: *Research in Carbonate Aggregate Reactions in Concrete*, 61H95.
Maddock, T., Jr., *Quarrying or Mining Versus Water Reservoirs*, 61H31.
Mussey, O. D.: *Water: Its Role in Mining and Beneficiating Iron Ore*, 61H81.
Price, W. L.: *Wire Cloth and Perforated Plate for Vibrating Screens* (NSGA Circular #80), 61H71.
Riggs, W. A.: *Transportation Economics of Mineral Commodities*, 61HK19.
Roetzer, A. A.: *Materials Handling, Transportation, and What Lies Ahead in Packaging in the Cement Industry*, 61HK50.
• Wilhelmy, O., Jr.: *Water Transportation of Fertilizer Raw Materials*, 61HK75.
Williams, V. C.: *Saline Water Conversion Economics*, 61H38.
Wollman, N.: *Our Future Water Needs—PMPC Forecast vs RFF Estimate*, 61H32.

MINERALS BENEFICIATION (B)

Bailey, C. N.: *Economic Factors Affecting Design of a Milling Plant*, 61B88.
Bergstrom, B. H., and Sollenberger, C. L.: *Kinetic Energy Effect in Single Particle Crushing*, 61B94.
Bond, F. C.: *Principles of Progeny in Comminution*, 61B15.
Bowdish, F. W.: *Theoretical and Experimental Studies of the Kinetics of Grinding in a Ball Mill*, 61B2.
Brown, W. N.: *Innovations in Large Volume Warehousing and Handling of Bulk Materials*, 61B72.
Browning, J. S.: *Flotation of North Carolina Spodumene-Beryl Ores*, 61B20.
Curtis, C. H.: *The Esperanza Concentrator*, 61B77.
Dor, A.: *Recent Trends in Iron Ore Beneficiation and Their Effect on Mill Design and Layout*, 61B54.
Dresher, W. H.: *A Mechanism Study of the Formation of Sodium Vanadate Compounds Under the Conditions of the Salt-Roast Process*, 61B48.
Gaudin, A. M., and Fuerstenau, M. C.: *Determination of Particle Size Distribution by X-Ray Absorption*, 61B3.
Helfrich, W. J., and Sollenberger, C. L.: *Relative Reduction Rates of Porous Iron Oxide Pellets*, 61B52.
Hoffman, I., and Mariacher, B. C.: *Beneficiation of Israeli Phosphate Ore*, 61B57.
• Howell, F., and Stoehr, R. J.: *Handling and Drying of Wet Ambrosia Lake Ores*, 61B93.
Larsen, E. P.: *Blending and Handling of Materials for Agglomeration*, 61B22.
Lash, L. D., and Ross, J. R.: *Scandium Recovery from Vitro Uranium Solutions*, 61B51.
Levine, N. M., and Fassel, W. M.: *The Technique of Gas Oxidation During Pulp Agitation*, 61B10.
Li, K. C.: *Chemical Processing of Tungsten Ores and Concentrates*, 61B7.
Peirce, J. W.: *Mass Flow Measurement of Mine Slurries*, 61B86.
Raring, R. H., and Murray, G. Y.: *Effect of Mining Operation and Tailings Disposal Requirements on Mill Design*, 61B39.
Sather, N. J.: *Concentrator Operation at the Bunker Hill Company*, 61B5.
Speers, E. C., and Woodruff, F. G.: *Materials Handling Facilities at the Ray Mines Division Expansion Program*, 61B14.
Sudbury, M. P., and Petkovich, F.: *Exothermic Hardening of Copper-Nickel Sulphide Agglomerates*, 61B40.
Takahashi, Y.; Serizawa M.; Miyagawa, K.; and Shimomura, Y.: *New Process in Sintering of Fine Iron Ores*, 61B6.
Thompson, C. D.; Czako, C. A.; and Violetta, D. C.: *Benefication of Cement Raw Materials by Dwight-Lloyd Processes*, 61B12.

MINING (A)

61AI02—*One Preprint Covering:*
• Just, E., and Parks, G.: *Research in Mining*, 61AI32A.
• Carpenter, R. H.: *Research in Exploration*, 61AI02B.
• Bates, C.: *Underground Nuclear Testing Detection, VELA UNIFORM, and Mineral Technology*, 61AI02C.
• Lyon, R. J. P., and Westphal, W. H.: *Future Trends in Mining and Exploration*, 61AI02D.

OPEN PIT MINING (AO)

Lackey, V. D.: *The 'Lectra Haul' Truck and Its Use on the Mesabi*, 61AO73.
• Pfleider, E. P., and Dufresne, C.: *Transporting Open Pit Production by the Truck-Ore Pass-Adit System*, 61AO56.
Stewart, R. M., and MacQueen, C. W.: *The Electric Wheel Truck in Anaconda's Operations*, 61AO84.
Vickers, E. L.: *Application of Marginal Analysis in the Determination of Cut-Off Grade, The* 61AO21.

UNDERGROUND MINING (AU)

Lang, T. A.: *Theory and Practice of Rock Bolting*, 61AU35.
Morlan, E. A.: *Boring Large Hole Mine Openings*, 61AU27.
Panek, L. A.: *Measurement of Rock Pressure with a Hydraulic Cell*, 61AU47.
Ryon, J. L., Jr.: *Underground Use of Ammonium Nitrate-Fuel Oil Explosives*, 61AU25.
Waples, B. R., Jr.: *Alimak Raise Climber at Iron King Branch of Shattuck Denn Mining Corporation*, 61AU26.

• Indicates Preprints not available in St. Louis, or those papers received at the Preprint Center after the meeting was in progress.

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ties analyst in mines, metals and minerals for Investors Diversified, to Toronto. He is now coordinator for Ventures Ltd.

C. E. Silverblatt has returned to the Research & Development Dept. of Eimco Corp. at Palatine, Ill., after a little over three years with the firm's English subsidiary. He will be primarily handling problems of overseas subsidiaries and agents.

After 19 years with American Smelting & Refining Co. where he was a design engineer, **Edwin B. Michal** has left Corpus Christi, Texas, to assist in the design of an electrolytic zinc smelter for Noranda Mines Ltd. in the Montreal area.

George W. Leney, senior geophysicist with the Hanna Mining Co., has been transferred from the Missouri to the Michigan district.

George D. Leigh, formerly operations engineer with Utah Construction & Mining Co., has joined LeTourneau-Westinghouse Co., Peoria, Ill., where he is production manager—trucks.

Jerry Huffman, a graduate student at The University of Missouri School of Mines, spent the summer working at the American Potash & Chemical Corp. plant in Henderson, Nev., as a research engineer.

John D. Gardner has become assistant to the president of Howe Sound Co. following completion of his work for a master's degree in business administration at Harvard Graduate School of Business Administration. Prior to that he had worked in the engineering department of the New Cornelia Branch of Phelps Dodge Corp.

D. M. Gillies was recently appointed director of research for Union Carbide Metals Co. in Niagara Falls, N. Y. Prior to his new appointment he had been assistant director of research for the Line Co. laboratories in Speedway, Ind.

William W. Karl has been appointed vice president of Nytralite Aggregate Inc., a newly formed subsidiary of New York Trap Rock Corp. He was formerly president of Lehigh Materials Co.

Goodman Mfg. Co. of Chicago has announced the appointment of **L. W. Peterson** to the post of sales manager of its newly created eastern division and **L. S. Ahlen** to a similar position in its new western division which

L. W. PETERSON

L. S. AHLEN

SHELDON JONES

H. D. HARDINGE

also includes Mexico, Canada and all overseas markets. Mr. Peterson has moved to Pittsburgh from his former post of manager of the company's Huntington, W. Va., sales district. **Sheldon Jones** replaces Peterson at Huntington, advancing from the position of assistant district manager.

At a recent meeting of the board of directors, **H. DeForest Hardinge** was appointed vice president of Hardinge Co., Inc., and Hardinge Mfg. Co. He has been assistant to the president.

After four years in Peru where he was engaged in exploration activities for Marcona Mining Co., **Howard F. Bartlett** has become a geologist for Utah Construction & Mining Co. attached to the newly formed Coal & Industrial Minerals Group operating out of Salt Lake City. Mr. Bartlett's first assignment is at the company's uranium operations at Shirley Basin, Wyo.

K. C. Stansmore, manager of international sales for Dorr-Oliver Inc., has been given the special assignment of coordinating all world-wide Dorr-Oliver work in the alumina field. During this period Mr. Stansmore will be relieved of other responsibilities in connection with international sales.

According to a recent announcement from The Berwind-White Coal Mining Co., **Charles S. Smith,** former district sales manager, has been appointed general sales manager.

Robert L. Olund, former branch manager at Salt Lake City, has been transferred to its Chicago branch by Ingersoll-Rand Co.

Following the development of the world's largest known lithia-brine deposit for Leprechaun Mining & Chemical Inc., **Gert E. J. H. Pralle,** who had been chief of the exploration division, has become vice president and mine manager of Bimetallist Mining Co. Inc., which is re-

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opening a small gold mine near the Campbird mine.

Frank E. Siegfreid, currently on leave from Standard Metals Corp., has purchased a substantial interest in a group of supermarkets in the area of Pueblo, Colo. He is vice president and manager of the enterprise known as Arapahoe Stores Inc.

Eugene Risch, formerly plant engineer for Western Nuclear Inc., is now project engineer for Harrison International Inc. which is sinking a shaft for Texas Gulf Sulphur Co., near Moab, Utah.

John W. Harshbarger, professor of geology at The University of Arizona since 1959, has been appointed head of the university's geology department. He succeeds **Frederic W. Galbraith** who retired late in 1960.

Paul C. Paulsen, formerly general loading foreman for U.S. Gypsum Co., is now with U.S. Borax & Chemical Corp., as a mining engineer.

G. S. CAMPUSANO

F. E. WOOD

After eight years with International Mining Co., in Bolivia, **German S. Campusano** has moved to Chile where he is assistant general manager for Empresa Minera Mantos Blancos S. A., a subsidiary of Mauricio Hochschild & Co. Ltd. which started operations in the early part of this year.

Fremont E. Wood, formerly chief engineer for Cyprus Mines Corp. has become chief consulting engineer for the company.

Lawrence E. Gordon, mining technician with USGS, has been transferred from Miami, Okla., to Carlsbad, N. M.

Following graduation from West Virginia University, where he received the Old Timers Club Award for 1961, **Philip G. Meikle** is a junior engineer with Duquesne Light Co.

F. A. SEETON

JAMES HYSLOP

Frank A. Seeton has been appointed manager of the Metallurgical Operations Div., Denver Equipment Co. He was formerly manager of mining and milling operations for Colorado Oil & Gas Corp.

James Hyslop has been elected a vice president of Consolidation Coal Co. He was formerly president of Consol's Hanna Coal Co. division.

Secretary of the Interior Stewart L. Udall recently announced the appointment of three division chiefs in the Office of Coal Research: **G. Edward Larson,** contracts and administration; **Neal P. Cochran,** utilization; and **Bernard S. Beckler,** economics and marketing.

Maurice Gratacap, who had been chief U. N. mining consultant to the Government of Bolivia, has gone to India to become chief consulting engineer to The Metal Corp. of India Ltd.

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M. A. KURYLA

G. J. COFFEY

NORMAN READMAN

The appointments of **Michael A. Kuryla,** manager and **Manuel Llosa,** deputy manager of the Lima (Peru) Div. of Cerro de Pasco Corp. were announced recently. Mr. Llosa was formerly technical advisor of the division and Mr. Kuryla was formerly deputy manager.

A. K. Schellinger has opened an office as an independent mineral engineering consultant in Golden, Colo. He recently visited S.W. Africa as metallurgical consultant on germanium, lead and copper processing development to Tsumeb Corp. Ltd.

L. A. Fekete, senior project engineer with Cy. Shell of Venezuela for six years, has become a project engineer for Gulf Interstate Engineering Co. in Houston.

Chicago Pneumatic Tool Co. recently announced the election of **Guy J. Coffey** as chairman of the board and chief executive officer of the company. He succeeds **H. Arnold Jackson** who will continue as a director and chairman of the executive committee. **Norman Readman,** formerly managing director of all overseas operations of the company, has been elected president to succeed Coffey. **Thomas F. Noonan** was elected vice president and comptroller. He has been comptroller for the past two years. **Carra L. Lane** was elected vice president and manager of plant operations.

According to a recent announcement from Engineering Foundation, research department of United Engineering Trustees Inc., **Antoine M. Gaudin** has been reelected chairman for another term.

The following officers were elected at a recent meeting of the directors of Island Creek Coal Co.: **R. E. Salvati,** chairman and chief executive officer; **James L. Hamilton,** president and chief administrative officer; **I. F. Freiberger,** chairman of the executive committee. Elected to newly created offices were: **F. A. Macdonald,** formerly general counsel, as vice president—law and **F. C. Honchell,** as vice president—finance. **B. E. Thornton** was elected controller, succeeding Mr. Honchell.

Paul C. Lingo, formerly deputy director, West Virginia Department of Mines, has become assistant safety director for the Bituminous Coal Operators' Assn.

Keith G. Parke has become geologist in charge of exploration with The Standard Slag Co. in Gabbs, Nev. He was formerly geologist with Southern Pacific Co.

After 10 years with Pittsburg Pacific Co. **Anthony T. Vellella** has retired to take a much needed rest. After the first of next year he will be available for consulting work.

Roland D. Parks, department of geology and geophysics, Massachusetts Institute of Technology, will be on leave of absence for the academic year 1961-62 as Fulbright lecturer in mining engineering at the University of Assiut, Assiut, Egypt. Enroute to Cairo he will visit some of the mining centers in Europe.

After nine years in Chile with Braden Copper Co. where he was

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smelter superintendent, **Norman F. Warren** has gone to the Transvaal, Union of South Africa to take the job of general superintendent with Palabora Mining Co.

Euclid P. Worden has been promoted from junior engineer to industrial sales representative by Hughes Tool Co. He will be serving mining and industrial rotary drilling operations in Nevada and California.

F. R. Sergiades has returned to England from Southern Rhodesia, where he was associated with Anglo American Corp. of South Africa.

Following graduation from the Colorado School of Mines, **George A. Holcomb** has gone to Peru to become a mining engineer with Cerro de Pasco Corp.

Jack R. Scott has gone to Liberia, West Africa to become mill superintendent for Liberia Mining Co. Ltd. He had been mill superintendent for Republic Steel Corp. at Mineville, N. Y.

A. T. Janssen, formerly in the engineer mechanics department of the Netherlands Institute for Documentation and Registration, has gone to Canada to become assistant mine engineer with Iron Ore Co. of Canada.

R. Kent Comann has been promoted from plant manager of the Florence gypsum plant of Fibreboard Paper Products Corp. to manufacturing manager—Gypsum Div. and transferred to San Francisco.

Brush Beryllium Co. has appointed **Thomas F. Bryant** West Coast sales engineer for beryllium alloys. Before joining Brush, Bryant was manager of industrial sales for the Pacific Coast Div. of the Colorado Fuel & Iron Corp.

C. C. Dickinson, president of Black Band Coal Co. and **R. H. Knode,** chairman of the executive committee, Stonega Coke & Coal Co., were honored by the board of the National Coal Assn. by being named *directors emeritus*. They are the only directors ever to be so designated. Both had been NCA presidents and members of the board of directors for 30 years or more.

Pavel Zima has accepted a position as mining engineer with Pittsburgh Pacific Co. at Hibbing, Minn. He was formerly with the consulting firm of Behre Dolbear & Co.

E. A. HICKOK

W. P. HEWITT

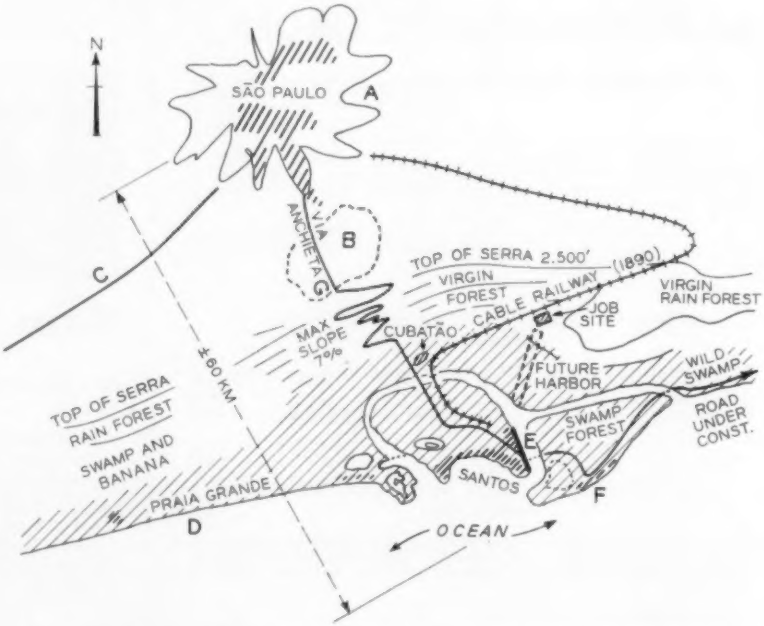
Eugene A. Hickok has been appointed general manager of the newly-formed Contract Div. of Geophysical Specialties Co. The new division will offer the services of engineers and geologists to contractors and others interested in the location and nature of subsurface rock formations and underground water supplies. Hickok is a specialist in underground water exploration and development and has recently returned from an assignment as staff hydrologist for International Development Services in Guatemala.

William P. Hewitt was recently appointed Director of the Utah Geological and Mineralogical Survey and professor in the geology department of the University of Utah, where he will serve half-time and teach courses in economic geology. He succeeds **Arthur L. Crawford,** who will continue with the Survey as assistant director. Dr. Hewitt was senior geologist of the Western Mining Dept. of American Smelting & Refining Co.

Alfred H. Cordes, Jr., Lytton A. Kendall, Jr. and **Robert F. Zimmerman** have been named application engineers of Allis-Chalmers' processing machinery department. Cordes and Kendall have been assigned to cement machinery sales and Zimmerman becomes a member of the company's minerals processing group.

Bethlehem Steel Co. announces the retirement of **Frank Storm,** vice president of Iron Mine Co. of Venezuela, effective October 1. He plans to remain in Caracas to devote his full attention to personal business. His company responsibilities will be assumed by **L. C. Yancy,** vice president and manager of Bethlehem's Venezuelan operations.

W. H. Hahne, a project engineer with Kaiser Engenharia e Construcoes Ltda., reports enthusiastically on the project being undertaken by Companhi Siderurgica Paulista on which his firm is acting as consultant. They are building a $200,000,000 integrated steel mill at the foot of the 2300 ft cliff between Santos and Sao Paulo. The potential is tremendous because the mill will open an area all the way to Santos which has been for 400 years a mangrove swamp with banana patches. There are 11 North Americans, six of whom are project engineers. Hahne is concerned with the L-D steel plant and kiln plants for limestone and dolomite.



W. H. Hahne's map of COSIPA project in relationship to Santos and Sao Paulo. Legend: A) 4 million people by November 1961 (about 100,000 in 1900). B) Many factory towns along highway and water reservoir for power plant at Cubatao. C) BR#2 new highway to Curitiba opens vast new area. D) 50 km of white beach and resorts (used by cars and busses when tide is low and not washed out). E) Biggest coffee harbor in the world. F) Guaruja (fancy resort). G) Until 1920 mule and horse drawn wagons along a 15 pct slope; 1920-25 first concrete road in Brazil—maximum 10 pct slope; then Anchieta 1—maximum 10 pct slope; and about 1948 Anchieta 2.

Obituaries

Wilber E. Stout (Member 1917), died May 20, 1961 at the age of 84. A native of Ohio, he was a graduate of Ohio State University, and his professional career was spent in his home state. After completing his early experience as a chemist with Columbus Iron & Steel Co. in 1912, he began his association with the Geological Survey of Ohio as a field geologist. By 1916 he was assistant geologist and by 1928 he became state geologist, the position he held until his retirement. As a ceramic engineer he did much to aid clay owners and members of the ceramic industry during his tenure as state geologist. He was also vitally interested in water resources and the problem of the continuous lowering of the water table in Ohio. His writings and the many publications issued by the Survey under his direction gained him friends among scien tists, educators, and industrialists throughout the country.

S. T. Allsbrook (Member 1944) died May 21, 1961 in Pittsburgh. He was born in Rison, Ark. on April 6, 1907, attended Tulane University for a year, then transferred to Mississippi State College from which he graduated in 1930. For six months after graduation he worked as concrete inspector, surveying for an 18-span railroad bridge and a 500-ft tunnel for Virginian Railway at Deepwater, W. Va. Early in 1931, Mr. Allsbrook went to work for the Koppers Coal Div., Eastern Gas & Fuel Associates, an association which continued until his death.

R. C. Crumbaugh (Member 1947) died at the age of 60 in Birmingham, Ala. He was born in Paducah, Ky. and attended the University of Mississippi as well as Vanderbilt University where he received his degree in engineering. While in college, he spent his summers working as chief of party and instrument man for a consulting engineer in Dyersburg, Tenn. Following graduation, he went to work as instrument man for the Louisville & Nashville RR. The following year he was employed by E. I. du Pont de Nemours as an explosives technican. His association with the firm and his career with explosives continued until his death.

John Daniell (Legion of Honor Member 1910) died July 7, 1960 at the age of 86. He was born in Allouez, Mich. and began his mining career in 1892 in underground work for Osceola Consolidated Mining Co. The following year he entered the Michigan College of Mines from which he graduated in 1898. His first job following graduation was as chief engineer for Franklin Mining Co. After working for several other companies in various capacities, Mr. Daniell became president and general manager of Finnish-American Mining Co. in 1910. In 1913 he began a consulting practice in Laurium, Mich., moving his headquarters to California in 1926, where he continued to reside until his death. He continued his consulting practice until a few years before his death.

Raymond R. Knill (Member 1952) died March 25, 1961 in Carlsbad, N. M. He was born August 6, 1900 in Lafayette, Colo. and was a graduate of the Colorado School of Mines. After completing his education he went to work for American Smelting & Refining Co. as a chemist. In 1924 he joined Union Pacific Coal Co., an association that lasted 20 years. In 1945 Mr. Knill moved to Carlsbad to become safety engineer and mine superintendent for Potash Co. of America. At the time of his death he was administrative assistant.

Leonard Peller (Member 1958) died recently in Philadelphia. A native of Chicago where he was born March 13, 1912, Mr. Peller was a graduate of the University of Illinois. Following graduation he worked in various positions in the engineering and construction of industrial and commercial projects. He served in the navy during World War II. Upon completion of his service, he went to work for United Engineers & Constructors handling the design and construction of chemical and metallurgical plants. In 1950 he was made supervising engineer in charge of this work, the position he held at the time of his death.

Roy E. Tremoureux (Member 1913), 77, died May 11, 1961 following emergency surgery to relieve rupture of the aorta. A native Californian, he was well-known in western Nevada County for his activities in the mining and business field for the past half century. He was born in San Jose, attended the University of California at Berkeley, and spent his summer vacations working in Grass Valley in the North Star mine. Both before and after service in World War I, Mr. Tremoureux worked for the Arthur D. Foote-James D. Hague interests. In 1920 he moved to San Francisco as a consulting engineer. In 1939 he headed the revived Clinch Mercantile Co., an historic business firm in Grass Valley. In 1946 the company purchased the Alpha Hardware Co. of Nevada City and Grass Valley and continued operations under that name. Mr. Tremoureux became a director and treasurer of the company. In 1948 he returned to Grass Valley to make his home.

Necrology

Date Elected	Name	Date of Death
1928	F. J. Adams	Apr. 10. 1961
1942	Harold E. Heide	June 20, 1961
1958	Russell P. Henry	Oct. 7, 1960
1958	Robert M. Keefe	June 17, 1961
1920	Wm. S. W. Kew	June 4, 1961
1953	E. M. Pittman, Jr.	Nov. 19, 1960
1920	C. E. S. Rau	Unknown
1940	A. Rostosky, Jr.	Aug. 3, 1960

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Total AIME membership on July 31, 1961, was 35,226; in addition 2,129 Student Members were enrolled.

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